I 72.12/11:89-0005

OCS EIS/EA
MMS 89-000

Gulf of Mexico Sales 123 and 125:

Central and Western Planning Areas

Draft Environmental Impact Statement

COMPLETED

U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Region

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Published by

U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Regional Office
New Orleans, Louisiana

New Orleans
March 1989

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REGIONAL DIRECTOR'S NOTE

The Environmental Impact Statement (EIS) covering the proposed OCS oil and gas lease sales in the Gulf of Mexico for 1990 is a product of the Minerals Management Service (MMS) in New Orleans, Louisiana. This document discusses the purpose and background of the proposed actions, the alternatives including the proposed actions, the description of the affected environment, and the environmental impacts of proposed Central Gulf of Mexico Sale 123 (March 1990) and Western Gulf of Mexico Sale 125 (August 1990).

This document makes reference to previous Final Environmental Impact Statements (Final EIS's) starting with the Final Regional EIS and seven intervening Final EIS documents. The most commonly referenced documents are the Final EIS's for the 1988 lease sales (Final EIS 113/115/116) and the Final EIS for the 1989 lease sales (Final EIS 118/122). Also referenced frequently are Visuals Nos. 2-7, which were last distributed with the EIS for Sales 113/115/116 (Visual No. 1 has been updated and is included with this document). Copies of these documents and visuals may be obtained from the MMS, Gulf of Mexico OCS Region, 1201 Elmwood Park Blvd., New Orleans, Louisiana 70123-2394 or may be viewed at any of the EIS depository libraries listed on the back of Visual No. 1.

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The cover is from an original inked drawing by Mr. William T. Johnstone. The overall design was developed by Mr. Wilfred Williams.

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COVER SHEET

Environmental Impact Statement for Proposed Central Gulf of
Mexico OCS Lease Sale 123 (March 1990) and Proposed
Western Gulf of Mexico OCS Lease Sale 125 (August 1990)

Draft (x) Final ( )

Type of Action:

Administrative (x) Legislative ( )

Area of Potential Impact:

Offshore Marine Environment and Coastal Counties/Parishes of Alabama, Mississippi, Louisiana, and Texas

Lead Agency:

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PUBLIC HEARINGS FOR PROPOSED CENTRAL AND WESTERN GULF OF MEXICO LEASE SALES 123 AND 125

In accordance with 30 CFR 256.26, public hearings pertaining to Draft EIS 123/125 will be held at the following locations:

New Orleans, Louisiana--Tuesday, April 25, 1989, 9 a.m. until all testimonies have been heard, MMS, Gulf of Mexico OCS Region, 1201 Elmwood Park Boulevard, Room 111, New Orleans, Louisiana.

Galveston, Texas--Tuesday, April 25, 1989, 9 a.m. until all testimonies have been heard, Rosenberg Library, 2310 Sealy, Room 125, Galveston, Texas.

The purpose of the public hearings is to provide the Department of the Interior and the Minerals Management Service with information from individuals, public and private groups, and government agencies to further evaluate issues addressed in the Draft EIS. Pertinent testimony and comments will be addressed in Final EIS 123/125.

SUMMARY

1. The Proposed Actions

This Environmental Impact Statement (EIS) addresses two proposed Federal actions that will offer for lease areas on the Gulf of Mexico Outer Continental Shelf (OCS) that may contain economically recoverable oil and gas resources.

Proposed Central Gulf Lease Sale 123 is scheduled to be held in March 1990 and will offer all unleased acreage in the Central Planning Area (CPA). As of December 1988, this was approximately 6,011 unleased blocks comprising about 32.1 million acres. This area includes acreage located from 3 to 220 miles offshore in water depths ranging from 4 to 3,425 m. There are no areas deferred from the proposed action, but there are alternatives to the proposed action and proposed mitigating measures available for adoption as described below.

Proposed Western Gulf Lease Sale 125 is scheduled to be held in August 1990 and will offer all unleased acreage in the Western Planning Area (WPA). As of January 1989, this was approximately 5,055 unleased blocks comprising about 27.8 million acres. This area is located from 9 to 222 miles offshore in water depths ranging from 8 to over 3,000 m. Excluded from this proposed action are Blocks A-375 (East Flower Garden Bank) and A-398 (West Flower Garden Bank) in High Island Area, East Addition, South Extension, which were deferred because of the environmentally sensitive nature of the biological communities located in the blocks. Alternatives to the proposed action and proposed mitigating measures are available for adoption as described below.

The proposed sale areas and the deferred blocks are depicted on Figure I-1. Sale areas and lease status are shown in detail on Visual No. 1.

2. Issues, Alternatives, and Proposed Mitigating Measures

A scoping process (Section I.B.2.) was used to obtain information and comments on the proposed actions from the affected states, Federal agencies, the petroleum industry, public interest groups, and concerned individuals. The input from these sources aided in the identification of major issues, possible alternatives to the proposed actions, and potential mitigating measures. The results of this effort and subsequent evaluations are as follows.

a. Significant Issues

	Central Gulf Sale 123		*Western Gulf Sale 125*
(1)	Sensitive Coastal Habitats	(1)	Sensitive Coastal Habitats
(2)	Sensitive Offshore Habitats and Communities	(2)	Sensitive Offshore Habitats and Communities
(3)	Water Quality	(3)	Water Quality
(4)	Air Quality	(4)	Air Quality
(5)	Endangered and Threatened Species	(5)	Endangered and Threatened Species
(6)	Marine Mammals	(6)	Marine Mammals
(7)	Birds Associated with the Coastal Area	(7)	Birds Associated with the Coastal Area
(8)	Commercial Fishing Industry	(8)	Commercial Fishing Industry
(9)	Recreational Beach Use	(9)	Recreational Beach Use
(10)	Archaeological Resources	(10)	Archaeological Resources

The potential impacts to the sensitive resources listed above from both proposed actions are analyzed in Section IV.D. of this document. Basic assumptions, estimates, and development scenarios used in these analyses are presented in Section IV.A. There are three separate analyses for each sensitive resource: the base case, the cumulative, and the high case. These scenarios represent best assumptions and estimates on a set of future conditions that are considered reasonably foreseeable and suitable for presale impact analyses. The Base Case estimates are based on the mean or "expected" case values of total undiscovered, unleased resources. The Base Case estimates are used for the principal impact analyses of the proposed sales and for the cumulative analyses, which also include the impacts of non-OCS-related activities. The High Case is used in supplemental analyses for comparative purposes. Table S-1 provides resource and offshore infrastructure estimates for the Base Case. Table

S-2 is a listing of the levels of impacts to the above sensitive resources as estimated under the various scenario analyses and alternative analyses in Section IV.D.

b. Alternatives

Central Gulf Sale 123

Alternative A (The Proposed Action): The proposed action is to offer for lease for oil and gas exploration and development all unleased areas within the CPA.

Alternative B (Delete Biologically Sensitive Offshore Habitats): This alternative would delete all 65 of the unleased blocks of the 167 total blocks on or near biologically sensitive areas of the topographic features in the Central Gulf.

Alternative C (No Action): This alternative equates to cancellation of the sale. Impacts and oil and gas production expected to result from the proposed action would not occur. Other potential alternative energy resources, which might be used to replace this lost resource production, are described in Section IV.D.1.c.

Western Gulf Sale 125

Alternative A (The Proposed Action): The proposed action is to offer for lease for oil and gas exploration and development all unleased areas within the WPA, with the exception of Blocks A-375 (East Flower Garden Bank) and A-398 (West Flower Garden Bank) in High Island Area, East Addition, South Extension.

Alternative B (Delete Biologically Sensitive Offshore Habitats): This alternative would delete all 82 of the unleased blocks of the 200 total blocks on or near biologically sensitive areas of the topographic features in the Western Gulf.

Alternative C (No Action): This alternative equates to cancellation of the sale. Impacts and oil and gas production expected to result from the proposed action would not occur. Other potential alternative energy resources, which might be used to replace this lost resource production, are described in Section IV.D.1.c.

c. Proposed Mitigating Measures

Central Gulf Sale 123

Protection of Biological Resources (Topographic Features and Live Bottoms): The topographic features stipulation is designed to protect the sensitive biota associated with the various banks of the Central Gulf of Mexico. The stipulation, if applied, would impose operating restrictions on oil and gas activities near identified banks in the form of no activity zones, zones in which shunting is required, and, in one case, a monitoring zone. The live bottom (pinnacle trend) stipulation is designed to protect the pinnacle trend environment in the Central Gulf of Mexico. The stipulation requires that a live bottom survey be conducted to identify potential live bottoms. Mitigating measures are imposed if significant live bottoms are identified. The stipulations and a discussion of their effects are located in Sections II.A.1.c.(1) and (2).

Protection of Archaeological Resources: The archaeological survey requirement of the stipulation is proposed for application on all leases that fall within archaeological resource zones 1 and 2. Zone 1 has a high potential for the occurrence of historic shipwrecks and for prehistoric sites. Zone 2 has a high potential only for prehistoric sites. The stipulation serves to reduce the potential for development-related impacts to archaeological sites by requiring remote sensing surveys within archaeological zones 1 and 2 prior to lease developments. These surveys, by recording evidence of potential archaeological resource locations, make avoidance or mitigation of impacts possible. The stipulation and a discussion of its effects are located in Section II.A.1.c.(3).

Mitigation of Conflicts with Military Activities: A stipulation is proposed for application on all leases within the designated military use/warning areas. The effect of the stipulation would be to reduce potential conflicts between military missions and service-boat traffic and helicopter flights. The stipulation and a discussion of its effects are located in Section II.A.1.c.(4).

Western Gulf Sale 125

Protection of Biological Resources (Topographic Features): The topographic features stipulation is the only biological measure offered for the Western Gulf and is similar to the one described for the Central Gulf. The stipulation and a discussion of its effects are located in Section II.B.1.c.(1).

Protection of Archaeological Resources: The archaeological stipulation for the Western Gulf is identical to the one described for the Central Gulf and a discussion of its effects is located in Section II.B.1.c.(2).

Mitigation of Conflicts with Military Activities: A stipulation is proposed for application on all leases within the designated military use/warning areas. The effect of the stipulation would be to reduce potential conflicts between military missions and service-boat traffic and helicopter flights. The stipulation and a discussion of its effects are located in Section II.B.1.c.(3).

Table S-1

Resource and Offshore Infrastructure Estimates: Sales 123 and 125

	Central Planning Area Sale 123 Base Case	Western Planning Area Sale 125 Base Case
Acreage Available for Leasing[1] (million of acres)	32.1	27.8
Resources Expected to be Developed[2]		
Oil (billion bbls)	0.17	0.10
Gas (tcf)	1.64	1.48
Offshore Infrastructure		
Exploration and Delineation Wells	210	200
Platforms	25	20
Development Wells	290	220
Pipelines (miles)	125	100

Note: Tables IV-1 and IV-2 include estimates for the Cumulative and High Case Analyses. These analyses are described in Sections IV.D.1.d. (Central Gulf Sale 123) and IV.D.2.d. (Western Gulf Sale 125).

[1] Unleased acreage available for leasing (deferred acreage not included) as of December 1988 for the Central Gulf sale and as of January 1989 for the Western Gulf sale.

[2] The methodology used to estimate resources is explained in Appendix C.

Source: USDI, Minerals Management Service, 1989, Gulf of Mexico OCS Region estimates.

Table S-2

Comparison and Summary of Impact Levels[1] for Alternatives A-C in the Central Planning Area (Sale 123)

Resource Category	Alternative A Base Case[2]	Alternative A High Case[3]	Alternative A Cumulative[4]	Alternative B[5]	Alternative C[6]
Sensitive Coastal Habitats					
Coastal Barriers	VL	VL	VH	VL	NE
Wetlands	VL	VL	VH	VL	NE
Sensitive Offshore Habitats and Communities					
Live Bottom Areas (Pinnacle Trend)	M	M	M	M	NE
Deepwater Benthic Communities (Low Density)	L	L	L	L	NE
Deepwater Benthic Communities (High Density-"Bush Hill")	M	M	M	M	NE
Topographic Features	VH	VH	VH	VL	NE
Water Quality					
Coastal/Nearshore	L	M	H	L	NE
Offshore	L	L	M	L	NE
Air Quality	M[a]	M[a]	M	M[a]	NE
Endangered and Threatened Species					
Brown Pelicans	L	L	M	L	NE
Sea Turtles	L	L	H	L	NE
Whales	VL	L	L	VL	NE
Marine Mammals	L	L	L	L	NE
Birds Associated with the Coastal Area	VL	VL	M	VL	NE
Commercial Fishing Industry	L	L	H	L	NE
Recreational Beach Use	L[b]	L	M	L[b]	NE
Archaeological Resources					
Historic	VL[c]	VL[c]	VH	VL[c]	NE
Prehistoric	VL	VL	VH	VL	NE

VH - Very High	M - Moderate	VL - Very Low
H - High	L - Low	NE - No Effect

[1] For definitions of levels of impacts, see Table S-4.
[2] Alternative A - (Proposed Action) based on the Base Case.
[3] Alternative A - (Proposed Action) based on the High Case.
[4] Alternative A - (Proposed Action) based on cumulative impacts of all activities.
[5] Alternative B - Delete Biologically Sensitive Offshore Habitats.
[6] Alternative C - No Action.

[a] Some of the coastal counties/parishes have very low impacts. See Section IV.D.1.a.(4) for specific counties/parishes.

[b] As a result of proposed Sale 123, no impacts are estimated for major shorefront recreational beaches in Mississippi and Alabama, a very low level of impact is estimated for Texas, and a low impact is estimated for Louisiana.

[c] The listed impact level is for subplanning areas C-1 and C-4. The impact level for subplanning areas C-2 and C-3 is uncertain, but could be very high. A study presently being conducted for MMS by Texas A&M University will help to define more specific areas where a very high impact level is possible.

[d] The listed impact level is for off Louisiana. The impact level off Mississippi and Alabama is expected to be moderate.

Table S-3

Comparison and Summary of Impact Levels[1] for Alternatives A-C in the Western Planning Area (Sale 125)

Resource Category	Alternative A Base Case[2]	Alternative A High Case[3]	Cumulative[4]	Alternative B[5]	Alternative C[6]
Sensitive Coastal Habitats					
Coastal Barriers	VL	VL	VH	VL	NE
Wetlands	VL	VL	M	VL	NE
Sensitive Offshore Habitats and Communities					
Deepwater Benthic Communities (Low Density)	L	L	L	L	NE
Deepwater Benthic Communities (High Density-"Bush Hill")	M	M	M	M	NE
Topographic Features	VH	VH	VH	VL	NE
Water Quality					
Coastal/Nearshore	L	L	M	L	NE
Offshore	L	L	M	L	NE
Air Quality	M[a]	M[a]	M	M[a]	NE
Endangered and Threatened Species					
Brown Pelicans	L	L	M	L	NE
Sea Turtles	L	L	H	L	NE
Whales	VL	L	L	VL	NE
Marine Mammals	L	L	L	L	NE
Birds Associated with the Coastal Area	VL	VL	M	VL	NE
Commercial Fishing Industry	L	L	H	L	NE
Recreational Beach Use	L	L	H	L	NE
Archaeological Resources					
Historic	VL[b]	VL[b]	VH	VL[b]	NE
Prehistoric	VL	VL	VH	VL	NE

VH - Very High
H - High
M - Moderate
L - Low
VL - Very Low
NE - No Effect

[1] For definitions of levels of impacts, see Table S-4.
[2] Alternative A - (Proposed Action) based on the Base Case.
[3] Alternative A - (Proposed Action) based on the High Case.
[4] Alternative A - (Proposed Action) based on cumulative impacts of all activities.
[5] Alternative B - Delete Biologically Sensitive Offshore Habitats.
[6] Alternative C - No Action.

[a] Some of the coastal counties/parishes have very low and low impacts. See Section IV.D.2.a.(4) for specific counties/parishes.

[b] The listed impact level is for subplanning areas W-2 and W-3. The impact level for subplanning areas W-1 is uncertain, but could be very high. A study presently being conducted for MMS by Texas A&M University will help to define more specific areas where a very high impact level is possible.

Table S-4

Definitions Assumed in Impact Assessment

	Very High	High	Moderate	Low	Very Low
Sensitive Coastal Habitats	Very severe long-term adverse effects: more than 2% of the habitat area destroyed or altered; or loss/interference due to oil spill contacts with sensitive coastal habitats (4 or more).	Major long-term adverse effects: 1%-2% of the habitat area destroyed or altered; or loss/interference due to oil spill contacts with sensitive coastal habitats (2-3).	Moderate adverse effects: 0.25%-1% of the habitat area destroyed or altered; or loss/interference due to oil spill contacts with sensitive coastal habitats (1).	Minor adverse effects: 0.02%-0.25% of the habitat area destroyed or altered; no spill contacts with sensitive coastal habitats.	Negligible to minor effects: 0.02% or less of the habitat area destroyed or altered; no spill contacts with sensitive coastal habitats.
Sensitive Offshore Habitats					
a. Live Bottoms (Pinnacle Trend) (Central Gulf only)	Substantial and permanent destruction of a large portion of the pinnacle environment and the assemblage thereon.	Mortality of the pinnacle community and destruction of the environment such that recovery is long-term (greater than one year).	Substantial damage to a localized area. Recovery will be long-term.	Short-term interference with ecological relationships. Recovery is short-term (less than one year).	Localized short-term interference with ecological relationships.
b. Deepwater Benthic Communities	A species, population, community, or assemblage will be harmed to the extent that recovery of that particular entity may not occur.	A significant interference with ecological relationships. This usually involves the mortality or a biological alteration of a noticeable segment of the population, community, or assemblage.	A short-term interference with ecological relationships. Although some species may sustain substantial losses, other species will sustain low losses, and the ecological mix will not be altered.	A few species may sustain low losses, but any interference with ecological relationships will not be evident.	Loss of a few individuals but no interference with ecological relationships.
c. Topographic Features	A species or population or a substantial portion of a topographic feature's biologic community or assemblage will be harmed to the extent that recovery of that particular entity may not occur.	A significant interference with ecological relationships. This usually involves the mortality or a biological alteration of a noticeable segment of the population, community, or assemblage. Recovery may occur.	A short-term interference with ecological relationships. Although some species may sustain substantial losses, other species will sustain low losses, and the ecological mix will not be altered.	A few species may sustain low losses, but any interference with ecological relationships will not be evident.	Loss of a few individuals but no interference with ecological relationships.
Water Quality	Water quality parameters change significantly by several orders of magnitude; toxic trace metals or hydrocarbons exceed USEPA safe levels; changes persist for months or longer.	Water quality parameters change significantly by one or two orders of magnitude; toxic trace metals or hydrocarbons near USEPA safe levels; changes persist for days to weeks.	Statistically significant changes in water quality parameters which persist for several weeks.	Some measures of water quality deviate significantly from ambient measures but are quickly (within 1-2 days) restored to normal.	Normal measures of water quality such as oxygen content, salinity, temperature, transmittance, trace metal concentrations, and hydrocarbon levels show no statistically significant changes from ambient conditions.

Table S-4. Definitions Assumed in Impact Assessment (continued)

	Very High	High	Moderate	Low	Very Low
Air Quality	Offshore or onshore sources significantly increase levels of criteria pollutants such that non-attainment areas will be degraded further or attainment and PSD areas are significantly degraded.* Significant effects on public health and welfare are expected.	Offshore or onshore sources increase levels of criteria pollutants such that nonattainment areas are likely to be degraded less than significantly and attainment and PSD areas are likely to degrade.* Likely to pose hazards to public health and welfare.	Offshore or onshore sources increase levels of criteria pollutants such that nonattainment areas are likely to experience minor degradation and attainment and PSD areas are not likely to degrade significantly.* Unlikely to pose hazards to public health and welfare.	Offshore or onshore sources increase levels of criteria pollutants such that nonattainment areas are unlikely to be degraded further and attainment and PSD areas are likely to undergo only very small increases in levels of criteria pollutants.* Very unlikely to pose hazards to public health and welfare.	Offshore or onshore sources increase levels of criteria pollutants such that nonattainment areas are very unlikely to be degraded further and attainment and PSD areas are likely to undergo negligible increases in levels of criteria pollutants.* Does not pose any hazard to public health and welfare.
Endangered and Threatened Species	A population declines in the affected area, resulting in a change in the distribution and/or abundance (greater than 5%) of the species in the local area and/or the planning area. The expected duration of the effects within the local area and/or the planning area is more than three generations** or 10 years or more.	A population declines in the affected area, resulting in a change in the distribution and/or abundance (less than or equal to 5%) of the species in the local are and/or the planning area. The expected duration of the effects within the local area and/or the planning area is two or three generations or 6-9 years.	A population declines in the affected area, resulting in a change in the distribution and/or abundance (less than or equal to 1%) of the species in the local area and/or the planning area. The expected duration of the effects within the local area and/or the planning area is one generation or 3-5 years.	A population declines in the affected area, resulting in a change in the distribution and/or abundance of the species in the local area and/or the planning area. The expected duration of the effects within the local area and/or the planning area is less than one generation or 1-3 years.	No discernible lethal effects, but individuals experience sublethal effects which cause reduced biogenic activity or reduced metabolic functions. Organisms would recover to preimpact condition in less than one generation or 1-2 years.
Marine Mammals	A population declines in the affected area, resulting in a change in the distribution and/or abundance of species in the local area and/or the planning area. The expected duration of the effects within the local area and/or the planning area is more than three generations** or 10 years or more.	A population declines in the affected area, resulting in a change in the distribution and/or abundance of the species in the local area and/or the planning area. The expected duration of the effects within the local area and/or the planning area is two or three generations or 6-9 years.	A population declines in the affected area, resulting in a change in the distribution and/or abundance of the species in the local area and/or the planning area. The expected duration of the effects within the local area and/or the planning area is one generation or 3-5 years.	A population declines in the affected area, resulting in a change in the distribution and/or abundance of the species in the local area and/or the planning area. The expected duration of the effects within the local area and/or the planning area is less than one generation or 1-3 years.	No discernible lethal effects, but individuals experience sublethal effects which cause reduced biogenic activity or reduced metabolic functions. Organisms would recover to preimpact condition within one generation or 1-2 years.
Birds Associated with the Coastal Area	A population declines in the affected area, resulting in a change in the distribution and/or abundance of the species in the local area and/or the planning area. The expected duration of the effects within the local area and/or the planning area is more than three generations** or 10 years or more.	A population declines in the affected area, resulting in a change in the distribution and/or abundance of the species in the local area and/or the planning area. The expected duration of the effects within the local area and/or the planning area is two or three generations or 6-9 years.	A population declines in the affected area, resulting in a change in the distribution and/or abundance of the species in the local area and/or the planning area. The expected duration of the effects within the local area and/or the planning area is one generation or 3-5 years.	A population declines in the affected area, resulting in a change in the distribution and/or abundance of the species in the local area and/or the planning area. The expected duration of the effects within the local area and/or the planning area is less than one generation or 1-3 years.	No discernible lethal effects, but individuals experience sublethal effects which cause reduced biogenic activity or reduced metabolic functions. Organisms would recover to preimpact condition in less than one generation or 1-2 years.

Table S-4. Definitions Assumed in Impact Assessment (continued)

	Very High	High	Moderate	Low	Very Low
Commercial Fishing Industry	An economic loss of greater than 5% to the commercial fishing industry, many fishermen out of work, and secondary employment (processing plants, etc.) substantially affected.	A 1%-5% economic loss to the commercial fishing industry, some fishermen out of work, and secondary employment affected.	A 0.1%-1% economic loss to the commercial fishing industry, some financial loss to fishermen, and secondary employment affected.	A 0.01%-0.1% economic loss to the commercial fishing industry, some fishermen affected, but no effect on secondary employment.	A 0.01% or less economic loss to the commercial fishing industry, and a few fishermen affected.
Recreational Beach Use	The overall quantity of major recreational beaches in the region will permanently change and/or a persistent change in the quality of a majority of the major beaches will be evident.	The quality of a small percentage (those associated with at least one community) of the major recreational beaches in the region will be permanently affected. Sustained influence (one or more years) on the type and intensity of beach-related recreational activities is expected to influence regional and subregional displacement of recreational use.	The quality of a large percentage (more than one community or political subdivision) of the major recreational beach environment is minimal yet perceivably affected in a sustained manner, yet the level and type of recreational activity is not changed. Acute, short-term damage to individual beaches can occur.	The quantity or quality of the major recreational beach environment does not change in a perceptible or sustained manner either regionally or subregionally; acute, short-term damage to individual recreational beaches is slight; and the influence on one or more beach-related recreational activities is not major.	The quantity and quality of major recreational beaches does not change; short-term damage to individual recreational beaches is negligible. Impacts do not preclude recreational use, although they may cause minor inconveniences to local users or site administrators.
Archaeological Resources	An interaction between an archaeological site and an impact producing factor occurs and results in the loss of unique archaeological information.	An interaction between an archaeological site and an impact producing factor occurs and results in the loss of significant,*** but not unique, archaeological information.	An interaction between an archaeological site and an impact producing factor occurs and results in the loss of archaeological data that are not significant.***	An interaction between an archaeological site and an impact producing factor occurs, but impacts are temporary and reversible.	Little damaging interaction between an impact producing factor and an archaeological site occurs.

*Note that levels of degradation of PSD areas are relative to whether they are a Class I, Class II, or Class III area; i.e., very small changes in pollutant levels are considered significant for Class I areas. (See Tables IV-13 and IV-14 for significant levels).

**A generation is the term of years accepted as the average period between the birth of the parents and the birth of their offspring.

***Significance as per National Register criteria.

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ABBREVIATIONS AND ACRONYMS

ACAA	Alabama Coastal Area Act of 1976
ACAMP	Alabama Coastal Area Management Program
AEC	Atomic Energy Commission
AEMA	Alabama Environmental Management Act
APD	Application for Permit to Drill
API	American Petroleum Institute
ARTC	Armament Research and Test Center
BAST	Best Available and Safest Technology
bbls	barrels
BBO	billion barrels of oil
BLM	Bureau of Land Management
BOD	biological oxygen demand
BMR	Bureau of Marine Resources
B.P.	before present
Btu	British thermal unit
Call	Call for Information and Nominations
CEE	Center for Environmental Education
CEI	Coastal Environments, Inc.
CEIP	Coastal Energy Impact Program
CEQ	Council on Environmental Quality
CER	categorical exclusion review
CERCLA	Comprehensive Environmental Compensation and Liability Act
CFR	Code of Federal Regulations
CGA	Clean Gulf Associates
cm	centimeter
CMP	coastal management program
COE	Corps of Engineers
COG	Councils of Government
CPA	Central Planning Area
CSA	Continental Shelf Associates
CZM	Coastal Zone Management
CZMA	Coastal Zone Management Act
dBa	decibel
DECA	Department of Economic and Community Affairs
DEM	Department of Environmental Management
DEQ	Department of Environmental Quality
DM	Departmental Manual
DOC	Department of Commerce
DOCD	Development Operations Coordination Document
DOD	Department of Defense
DOE	Department of Energy
DOI	Department of the Interior (also: USDI)
DOT	Department of Transportation
DST	Deep Stratigraphic Test
dwt	deadweight tons
EA	environmental assessment
EEZ	Exclusive Economic Zone
EIS	environmental impact statement
EPA	Eastern Planning Area
FAA	Federal Aviation Administration
FCMA	Fishery Conservation and Management Act of 1976
FERC	Federal Energy Regulatory Commission

F.I.R.E.	finance, insurance, and real estate
FMC	Fisheries Management Council
FMP	Fishery Management Plan
FR	Federal Register
FRS	Fast Response System
ft	foot
FWPCA	Federal Water Pollution Control Act
FWS	Fish and Wildlife Service
FY	fiscal year
G&G	geological and geophysical
GIWW	Gulf Intracoastal Waterway
GS	Geological Survey
ha	hectare
HAPC	Habitat Area of Particular Concern
IMCO	Intergovernmental Maritime Consultative Organization
in	inch
IPF	impact producing factor
ITL	Information to Lessees
ITS	Incidental Take Statement
km	kilometer
LCRP	Louisiana Coastal Resources Program
LOOP	Louisiana Offshore Oil Port, Inc.
LNG	liquefied natural gas
LTL	Letter to Lessees and Operators
m	meter
MAFLA	Mississippi, Alabama, Florida
MCP	Mississippi Coastal Program
mi	mile
MIRG	Marine Industry Research Group
MMB	million barrels
MMS	Minerals Management Service
MOU	Memorandum of Understanding
NAAQS	National Ambient Air Quality Standards
NAS	National Academy of Sciences
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NERBC	New England River Basins Commission
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent to Prepare an EIS
NPDES	National Pollution and Discharge Elimination System
NPS	National Park Service
NRC	Nuclear Regulatory Commission
NRT	National Response Team
NTL	Notice to Lessees
NWR	National Wildife Refuge
OCRM	Office of Ocean and Coastal Resource Management
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OSC	On-Scene Coordinator
OSCP	Oil Spill Contingency Plan
OSRA	Oil Spill Risk Analysis
PAH	polynuclear aromatic hydrocarbon

PCB's	polychlorinated biphenyls
PINC	Potential Incident of Noncompliance
P.L.	Public Law
ppm	parts per million
PSD	Prevention of Significant Deterioration
PWSA	Ports and Waterways Safety Act
RCRA	Resource Conservation and Recovery Act
RD	Regional Director
ROTAC	Regional Operations Technology Assessment Committee
RPC	Regional Planning Council
RRT	Regional Response Team
RTWG	Regional Technical Working Group
SIC	Standard Industrial Classification
SMA	Special Management Area
SMSA	Standard Metropolitan Statistical Area
SPR	Strategic Petroleum Reserve
SUSIO	State University System of Florida, Institute of Oceanography
tcf	trillion cubic feet
TPA	Total Planning Area
TSP	total suspended particulates
TSS	traffic separation schemes
U.S.	United States
U.S.C.	United States Code
USAF	U.S. Air Force
USCG	U.S. Coast Guard
USDC	U.S. Department of Commerce
USDI	U.S. Department of the Interior (also: DOI)
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
VOC	volatile organic compounds
WPA	Western Planning Area
yd	yard

PURPOSE AND BACKGROUND OF THE PROPOSED ACTIONS I

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SECTION I

PURPOSE AND BACKGROUND OF THE PROPOSED ACTIONS

I

I. PURPOSE AND BACKGROUND OF THE PROPOSED ACTIONS

A. PURPOSE AND NEED

The Department of the Interior (DOI) is required under the Outer Continental Shelf Lands Act (OCSLA), as amended, to manage the leasing, exploration, development, and production of oil and gas resources on the Outer Continental Shelf (OCS). The Nation's energy goals demand that the hydrocarbon resources of the Gulf be inventoried as rapidly and yet as carefully as possible to allow their timely development and production. The Secretary of the Interior (Secretary) oversees this process and is required to balance orderly resource development with protection of the human, marine, and coastal environments and to ensure that the public receives an equitable return for these resources and that free market competition is maintained. The offering for lease of areas on the Gulf of Mexico OCS that may contain recoverable oil and gas resources is the purpose of the two proposed Federal actions addressed in this Draft Environmental Impact Statement (EIS). Both proposed sales are part of the DOI's current 5-Year Oil and Gas Leasing Program, which covers the period mid-1987 to mid-1992.

Proposed Central Gulf Lease Sale 123 is scheduled to be held in March 1990 and will offer approximately 6,011 unleased blocks (as of December 1988) comprising about 32.1 million acres in the Central Planning Area (CPA). This area includes acreage located from 3 to 220 miles offshore in water depths ranging from 4 to 3,425 m. There are no areas deferred from the CPA, but there are alternatives to the proposed action and protective mitigation measures available for adoption as described below.

Proposed Western Gulf Lease Sale 125 is scheduled to be held in August 1990 and will offer approximately 5,055 unleased blocks (as of January 1989) comprising about 27.8 million acres in the Western Planning Area (WPA). This area is located from 9 to 222 miles offshore in water depths ranging from 8 to over 3,000 m. Excluded from this proposed action are Blocks A-375 (East Flower Garden Bank) and A-398 (West Flower Garden Bank) in High Island Area, East Addition, South Extension, which were deferred because of the environmentally sensitive nature of the biological communities located in the blocks. There are also alternatives to the proposed action and protective mitigating measures available for adoption as described below.

The proposed sale areas and the deferred blocks are depicted in Figure I-1. Sale areas and lease status are shown in detail on Visual No. 1.

B. BACKGROUND OF THE PROPOSED ACTIONS

1. Administrative Events Leading to the Proposed Actions

The process leading to these sales began when the Call for Information and Nominations (Call) and the Notice of Intent to Prepare an EIS (NOI) for the 1990 lease sales was published in the *Federal Register* on May 19, 1988. Copies of the Call/NOI were also mailed to individuals; environmental groups; Federal, State, and local government agencies; and industry to ensure that those with an interest in the OCS program would have an opportunity to participate in the process. Additional requests for specific environmental/resource information were sent to Federal and State agencies on May 26, 1988.

2. Scoping Activities and Findings

Scoping is the process by which issues related to the proposed actions are identified. Leasing on the Gulf of Mexico OCS has been occurring for over 30 years and, as a result, most of the pertinent environmental and socioeconomic issues have been known for some time. This is the thirty-first EIS analyzing the impacts of oil and gas leasing in the Gulf of Mexico. As for previous EIS's, a scoping effort was conducted for this Draft EIS to provide further information for the development of appropriate alternatives and mitigating measures, and to identify new issues and eliminate existing issues that may not need further treatment in the EIS. The governors of the Gulf States, State and Federal agencies, industry, environmental groups, and interested individuals were given an opportunity to comment. A detailed description of the EIS consultation and coordination process is located in Section V.B.

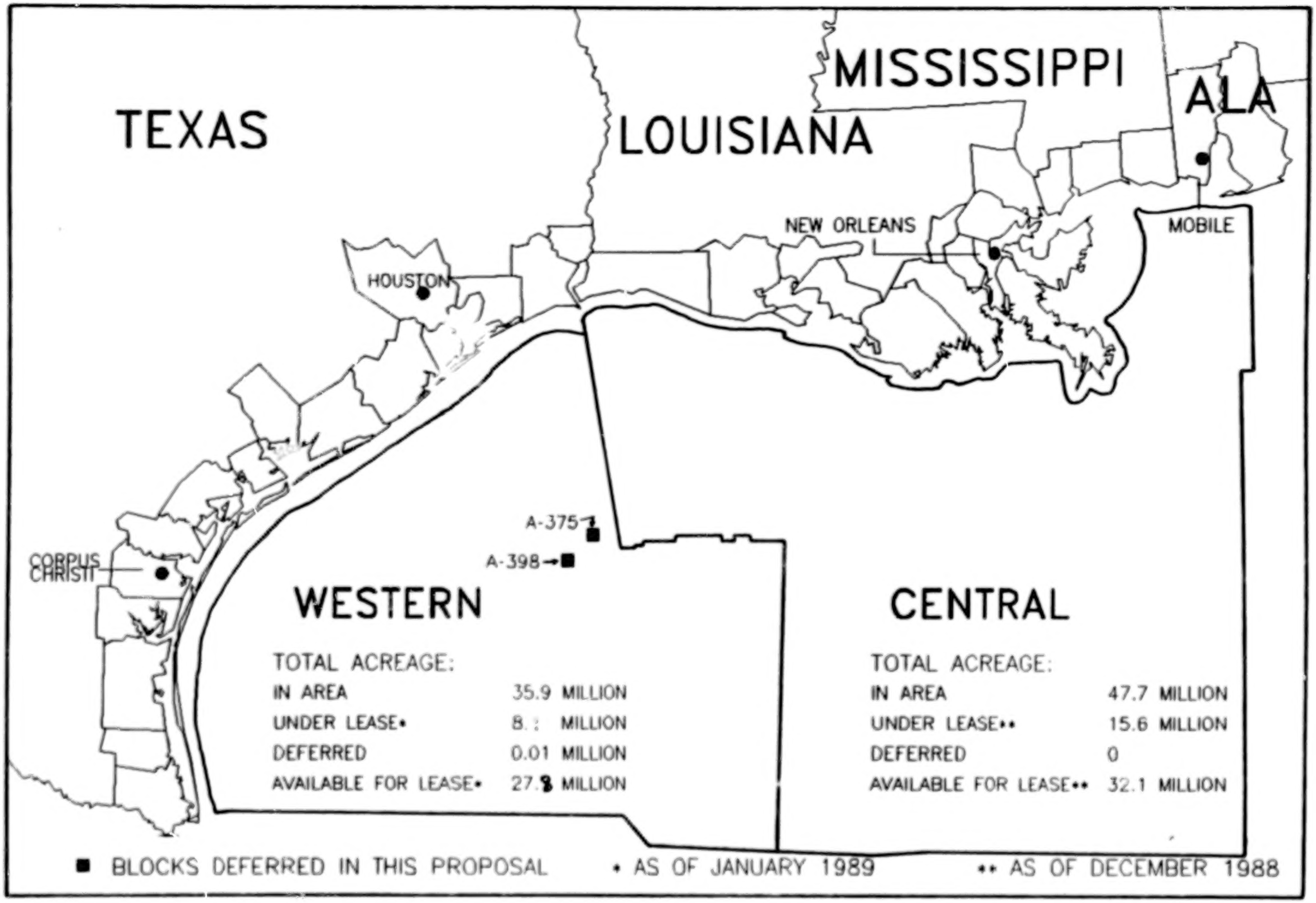


Figure I-1: Central Gulf Sale 123 and Western Gulf Sale 125 Areas.

a. Alternatives

(1) Alternatives for Central Gulf Sale 123

Alternative A (The Proposed Action): The proposed action is an offer to lease all unleased areas (approximately 32.1 million acres or 6,011 blocks) within the CPA for oil and gas exploration and development. It is estimated that the proposal could result in the production of 0.17 billion bbls of oil (BBO) and 1.64 trillion cubic feet (tcf) of gas after leases are issued and exploration occurs.

Alternative B (Delete Biologically Sensitive Offshore Habitats): This alternative would delete all 65 of the unleased blocks of the 167 total blocks on or near biologically sensitive areas of the topographic features in the Central Gulf.

Alternative C (No Action): This alternative equates to cancellation of the sale. Potential impacts and oil and gas production, which could result from the proposed action, would not occur. Other potential alternative energy resources that might be used to replace this lost resource production have been analyzed and assessed in Section IV.D.1.c.

(2) Alternatives for Western Gulf Sale 125

Alternative A (The Proposed Action): The proposed action is an offer to lease for oil and gas exploration and development all unleased areas within the WPA, with the exception of the following blocks excluded from the Call: Block A-375 (East Flower Garden Bank) and Block A-398 (West Flower Garden Bank) in High Island Area, East Addition, South Extension. Approximately 27.8 million acres or 5,055 blocks will be available for lease. It is estimated that the proposal could result in the production of 0.10 BBO and 1.48 tcf of gas.

Alternative B (Delete Biologically Sensitive Offshore Habitats): This alternative would delete all 82 of the unleased blocks of the 200 total blocks on or near biologically sensitive areas of the topographic features in the Western Gulf.

Alternative C (No Action): This alternative equates to cancellation of the sale. Potential impacts and oil and gas production, which could result from the proposed action, would not occur. Other potential alternative energy resources that might be used to replace this lost resource production have been analyzed and assessed in Section IV.D.1.c.

(3) Alternatives Not Included in the EIS

The following alternatives to the proposed actions were considered but are not included in this Draft EIS.

Limit the Amount of Acreage in Any One Sale: This alternative was proposed by the State of Louisiana as a means of controlling economic cycles that stress regional economies through broad fluctuations in oil and gas activity. If a limitation on the size of the lease offering was made, the specific limitation would be determined by the Secretary of the Interior when a decision to hold a sale is made. The EIS is not a decision document. Limiting the acreage available for a lease sale is beyond the scope of this document.

Substitute Alternative Forms of Energy for the Proposed Action: The substitution of alternative energy (solar, wind power, etc.) was recommended as an alternative to the proposed actions. Alternative C (No Action) equates to cancellation of the sale. If Alternative C is selected, it may be assumed that energy not produced by oil and gas developed as a result of the proposed actions would be replaced, at least in part, by energy from other sources that are discussed in Section IV.D.1.c.

b. Mitigating Measures

(1) Proposed Mitigating Measures Included in the EIS

Protection of Biological Resources (Topographic Features and Live Bottoms): The topographic features stipulations are designed to protect the sensitive biota associated with the various banks of the Central and Western Gulf of Mexico. The stipulations, if applied, would impose operating restrictions on oil and gas activities near identified banks in the form of no activity zones, zones in which shunting is required, and, in one case, a monitoring zone. The live bottom (pinnacle trend) stipulation is designed to protect the pinnacle trend environment in the

Central Gulf of Mexico. The stipulation requires that a live bottom survey be conducted to identify potential live bottoms. Mitigating measures are imposed if significant live bottoms are identified. The stipulations and a discussion of their effects are located in Sections II.A.1.c.(1) and (2) for the Central Gulf and Section II.B.1.c.(1) for the Western Gulf.

Protection of Archaeological Resources: The archaeological survey requirement of the stipulation is proposed for application on all leases that fall within archaeological resource zones 1 and 2. Zone 1 has a high potential for the occurrence of historic shipwrecks and for prehistoric sites. Zone 2 has a high potential only for prehistoric sites. The stipulation serves to reduce the potential for development-related impacts to archaeological sites by requiring remote sensing surveys within archaeological zones 1 and 2 prior to lease developments. These surveys, by recording evidence of potential archaeological resource locations, make avoidance or mitigation of impacts possible. The stipulation and a discussion of its effects are located in Section II.A.1.c.(3) for the Central Gulf and Section II.B.1.c.(2) for the Western Gulf.

Mitigation of Conflicts with Military Activities: A stipulation is proposed for application on all leases within the designated military use/warning areas. The effect of the stipulation will be to reduce potential conflicts between military missions and service-boat traffic and helicopter flights. The stipulation and a discussion of its effects are located in Section II.A.1.c.(4) for the Central Gulf and Section II.B.1.c.(3) for the Western Gulf.

(2) Mitigating Measures Not Included in the EIS

The following mitigating measures were considered but are not included in this Draft EIS:

(a) Regulation of Solid Waste Disposal Offshore

The State of Texas urged, in response to scoping, that MMS institute regulations for oil and gas leases that would prohibit the disposal of any refuse from vessels or structures in Federal waters. Such a mitigating measure is not proposed in this EIS because under existing OCS regulations (30 CFR 250.41) deliberate disposal of any solid waste or garbage items anywhere in the marine environment is strictly prohibited. Because of increased concern with the prevalence and effects of persistent marine debris both offshore and on coastal beaches, MMS issued a special advisory (NTL 86-11) in 1986 strongly encouraging industry to take special educational, operational, and awareness measures designed to reduce or eliminate the oil and gas industry's contributions to marine debris in the Gulf of Mexico.

(b) Mitigation Measures for Resources Experiencing High Cumulative Impacts

The State of Louisiana expressed concern in response to the Call/NOI that, while the cumulative and long term impacts to some resources have been ranked as high or very high by MMS, no specific mitigation alternatives have been proposed for their amelioration. Cumulative impacts are those resulting from OCS activities and all other impact-producing factors from any program or activity having an effect on the resource in question. The MMS, through its environmental studies program and in-house analyses, continues to develope an understanding of the contribution, if any, of OCS activities to the degradation of the resources of the Gulf and to establish mitigating measures where appropriate. Appropriate measures are those that mitigate OCS oil- and gas-related activities that impact, or have the potential to impact, environmental resources. Natural resource impacts are analyzed in the cumulative analyses of this document. Where OCS activities make enough of a contribution to cumulative impacts such that a mitigation measure will change the impact level, the analyses will indicate the nature of the measure to be considered. The measures must be within the jurisdictional authority of the agency.

c. Issues

(1) Significant Issues

The topics considered for analysis as significant issues in this EIS are separated into three categories based on the selection criteria described below. The categories are (a) those issues that meet each of the criteria and are, therefore, fully analyzed in the EIS; (b) those issues that meet each of the criteria, but for which no new information is available that would indicate a need for a thorough reevaluation of the levels of impact to the resources in question (these issues are briefly discussed and reference to the full analysis in past EIS's is made in accordance with the Council on Environmental Quality (CEQ) guidelines, Section 1501.7(a)(3)); and (c) those issues that were analyzed and do not meet all of the criteria and were, therefore, determined not to be of sufficient significance in either sale area to require analysis in the EIS.

SELECTION CRITERIA

- The resource/activity was identified through scoping or comments on a draft EIS.
- The resource/activity is vulnerable to one or more important impact producing factors (IPF's). To be vulnerable, the location and temporal aspects of the resource/activity must be such that an interaction with an IPF could occur. A reasonable probability of such an interaction should exist.
- The potential exists for a significant impact, considering the sensitivity of the resource to IPF's as the determining factor.

(a) Issues Fully Analyzed in the EIS

Resource	Description	Location in EIS
Sensitive Coastal Habitats a. Coastal Barriers b. Wetlands	Barrier islands and wetlands may be affected. IPF's include oil spills, construction of navigation channels and canals, emplacement of pipelines, construction of onshore facilities, maintenance dredging, and vessel traffic.	Sections IV.D.1.a.(1) and IV.D.2.a.(1)
Sensitive Offshore Habitats and Communities a. Live Bottom (Pinnacle Trend) Areas (Central Gulf) b. Deepwater Benthic Communities	Live bottom areas and deepwater benthic communities may be affected. IPF's include mechanical damage due to anchors, emplacement of drilling and support structures, and drilling operations and laying of pipelines; damage to the biota by smothering or by toxicity of drilling fluids, cuttings, produced water, oil spills, and resuspension of sediments due to a blowout.	Sections IV.D.1.a.(2) and IV.D.2.a.(2)
Water Quality a. Coastal/Nearshore	Coastal/nearshore water quality may be affected. IPF's include discharges related to catastrophic events and onshore and offshore operations.	Sections IV.D.1.a.(3) and IV.D.2.a.(3)
Air Quality	Air quality may be affected. IPF's include emissions from catastrophic events and onshore and offshore operations.	Sections IV.D.1.a.(4) and IV.D.2.a.(4)
Endangered and Threatened Species a. Brown Pelicans b. Sea Turtles c. Whales	Brown pelicans, sea turtles, and whales may be affected. IPF's include oil spills, offshore structure removals, geophysical exploration, increased vessel and air traffic, onshore facilities construction, and trash and debris.	Sections IV.D.1.a.(5) and IV.D.2.a.(5)

Marine Mammals	Bottlenose dolphins and whales may be affected. IPF's include oil spills, offshore structure removals, geophysical exploration, increased support vessel and air traffic, onshore facility construction, and trash and debris.	Sections IV.D.1.a.(6) and IV.D.2.a.(6)
Recreational Beach Use	Shorefront beaches supportive of intensive recreational activity may be affected. IPF's include trash and debris, oil spills, tar balls, pipeline landfalls, and onshore facilities construction.	Sections IV.D.1.a.(9) and IV.D.2.a.(9)
Archaeological Resources a. Historic b. Prehistoric	Unique historic and prehistoric archaeological data may be affected. IPF's include emplacement of offshore and onshore infrastructure, oil spills, and oil spill clean-up activities.	Sections IV.D.1.a.(10) and IV.D.2.a.(10)

(b) Issues Summarized and Referenced to Prior Analyses

Resource	Description	Location in EIS
Sensitive Offshore Habitats and Communities c. Topographic Features	Topographic features may be affected. IPF's include mechanical damage due to anchors, emplacement of drilling and support structures, drilling operations and laying of pipelines; damage to the biota by smothering or by toxicity of drilling fluids, cuttings, produced water, oil spills, and resuspension of sediments due to blowout.	Sections IV.D.1.a.(2) and IV.D.2.a.(2)
Water Quality b. Offshore	Offshore water quality may be affected. IPF's include discharges related to catastrophic events and onshore and offshore operations.	Sections IV.D.1.a.(3) and IV.D.2.a.(3)
Birds Associated with the Coastal Area	Coastal and marine bird species or regional populations may be affected. IPF's include oil spills, vessel and air traffic, pipeline landfalls, onshore facilities construction, and trash and debris.	Sections IV.D.1.a.(7) and IV.D.2.a.(7)
Commercial Fishing Industry	The economy of the commercial fishing industry may be affected. IPF's include oil spills, gear conflicts, and structure emplacement.	Sections IV.D.1.a.(8) and IV.D.2.a.(8)

(2) Topics Determined Not to Require Analysis in the EIS

The following topics have been scoped and analyzed, and it has been determined they are not of sufficient significance in either sale area to require in-depth analyses in the EIS. The last two topics (structure removal and deepwater activities) were recommended as significant issues during scoping; however, they are impact producing factors and are discussed as such in this EIS.

(a) *Community Infrastructure*

The topic of Community Infrastructure may be described as concern over the increased demand on existing community facilities systems and capacity due to an increased level of oil and gas activities. Such systems commonly include public, semi-public and private services and facilities, such as education, police and fire protection, utilities, etc.

This concern received public comment on Draft EIS 94/98/102 from the Louisiana Department of Natural Resources and on Draft EIS 113/115/116 from the Louisiana Department of Community Affairs. No new concerns have been recently expressed over this issue.

Recent trends in coastal Gulf of Mexico states indicate a decreasing population growth rate, a general increase in unemployment percentages, and a decrease in building permits since 1984. These general economic indicators reflect the decreased demands placed on existing community infrastructure. These trends are supported by less current and projected oil and gas exploration activity in the Gulf of Mexico. Community infrastructure already in place has sufficient capacity to accommodate any projected population change resulting from these sales. Our analyses for these sales indicates very low potential impacts resulting from the proposed actions.

(b) *Local Economic Conditions*

Concern exists over the probability that OCS-generated employment in adjacent coastal communities may adversely affect local economies. In particular, the State of Louisiana commented on Draft EIS 94/98/102 and expressed concern over the possible "boom/bust" economic impact from areawide sales.

The proposed action may generate direct, secondary, and induced employment. Direct employment includes jobs associated with the oil and gas extraction industry; secondary employment includes jobs associated with oil- and gas-related industries; and induced employment includes jobs supported by expenditures of direct and secondary employees. The MMS analysis for the 5-Year OCS Oil and Gas Leasing Program indicates that job opportunities created by sales proposed for the 1988-1992 time period will allow a continuation of some existing oil/gas-related jobs in the CPA and WPA rather than attract new residents into the region. Therefore, the 1989 lease sales, which are a part of that 5-year lease sale schedule, are expected to result in no adverse impacts on local economic conditions. Instead, the continuation of some existing employment and income is considered beneficial.

In the past, the States of Texas and Louisiana formally requested that an analysis be included in this document with regards to the recent economic downturn in the petroleum industry. Additionally, in a letter of comment on the NOI for the proposed sales, the State of Louisiana commented that the economic impacts of a declining industry are inadequately addressed. Section III of this document takes this information into consideration.

(c) *Marine Transportation*

The Gulf is used extensively for marine transportation involved in international and domestic commerce, commercial and recreational fishing, military operations, and other activities. The topic may be described as concern over whether or not increased OCS oil- and gas-related vessel traffic will adversely impact navigational safety in the Gulf and whether changes in current traffic patterns may be necessary due to OCS activity. Present information indicates OCS vessel traffic generated by the proposed sales will not lower navigational safety or cause changes in current traffic patterns.

The topic is not treated as a major issue in this EIS, but it will be addressed in at least three sections in the document, including the discussion of the responsibilities and regulations of other agencies, the description of socioeconomic environment, and the discussion of other offshore activities that contribute to cumulative impacts in the Gulf.

(d) *Ports*

Many of the ports located along the Central and Western Gulf coast are involved to some extent in activities associated with the exploration, development, and production of oil and gas in the Gulf. The topic of interest in regards to ports may be described as the impact of the OCS program on demand for additional port and harbor space, which generally involves temporary and permanent service bases and facilities necessary for the shipment of platform and pipeline materials. Many of the ports were developed to support the oil and gas industry and have been, and still are, actively competing for business. New major incremental demands on space are not taking place. Land for these ports has already been cleared and bulkheaded, and any additional use, especially in view of current downturns in regional economics, would be considered a positive economic impact.

(e) Tourist Activity/Industry

The topic of tourist activity/industry may be described as concern about oil spills and the deleterious effects of other related OCS activity (specifically trash and debris) affecting the tourism industry (especially at the beaches) in these two planning areas. This topic has been adequately analyzed in previous EIS's under the topics of tourism and recreational beaches. Beach use is the primary affected aspect of the tourism industry. Although no comments on tourism were received in direct response to the Call for Information and Comments for these proposed lease sales, further comments from the State of Texas and others indicate a continuing concern for the chronic effects of trash and debris on the coastal tourism industry.

The qualitative effects of trash and debris in the Western Gulf (where there is the most significant problem) will be discussed in the section on beach use. The impact of trash and debris on the tourism industry in Texas cannot be quantified since the problem, as has the tourism industry itself, has existed for many years. There are no visible losses in tourism receipts upon which to base a sound economic analysis. It is, therefore, impossible to ascertain the exact dollar amount of impact that trash and debris have on tourist areas in Texas.

(f) State and Local Land Use Management

The topic of state and local land use management may be described as concern over the possibility that the increase in the number of leases resulting from the proposed actions may cause an increase in the level of OCS oil and gas activity which, in turn, may cause growth and development in the coastal zone to occur at such an accelerated rate that State and local governments may be unable to plan effectively.

This concern was treated in prior EIS's. Our analyses have assessed very low impacts. No new data have become available that would change the impact assessment, and little public comment expressing concern over this issue has been noted recently, possibly because of the downturn in the oil and gas industry and the availability of existing infrastructure. Current indications are that land use is not a major or significant issue.

(g) Water Supply

Previous analyses have shown that large quantities of freshwater are used both offshore and onshore to support a number of OCS-related activities. Such activities are varied and consist of drilling operations, platform fabrication, and oil/gas processing. Although the quantities appear to be quite large in respect to the daily industrial uses on a county/parish basis, the previous proposal estimates equate to less than or 0.1% of their daily use. Therefore, the previous proposals have had a very low to negligible impact to regional water supplies.

Also, the question of whether there will be sufficient water to support future oil and gas operations in the Gulf is addressed in detail subsequent to the lease sales at the time the required exploratory drilling plans are submitted to the States for review and approval. These plans describe proposed offshore and onshore operations and facilities and other requirements, including the estimated amount of water consumption. States with approved coastal zone management (CZM) plans are required to make a determination that the proposed exploration plan is consistent with the CZM plans; historically, all plans have been found to be consistent. This procedure assures that State and local officials have the opportunity to review and approve, or disapprove, water-use elements before they became large and unmanageable.

(h) Coastal Seagrasses

Coastal seagrass beds occurring in the CPA and WPA have not been raised as an issue during MMS scoping activities. They are included in this discussion because past EIS analyses have examined the effects of Federal OCS operations on coastal seagrasses along the Gulf Coast. However, with the exception of Florida seagrasses, these previous analyses addressed seagrasses within the context of the wetland analysis and determined negligible interaction. Seagrasses occur infrequently in the CPA as scattered, discontinuous beds in open water areas embedded in wetland areas. Seagrass beds in Texas are somewhat more frequent and are associated with the semi-protected lagoons located behind barrier islands. The vast majority of seagrasses are located in the EPA. The description of coastal seagrasses is included in Section III.B.1.c. for general information. Previous analyses determined that any adverse effects on a wetland area or a barrier island by OCS oil spills or displacement operations would likewise impact embedded seagrasses. Based on the above, therefore, no separate analysis is presented for seagrasses in this EIS. The reader should consider that seagrass impacts are treated as components of coastal habitats, rather than addressed independently.

(i) Military Areas

The CPA has two military warning areas and a portion of another which extends into the Eastern Gulf and comprises approximately 15% of the area. The WPA has two military warning areas which comprise 33% of the areas. The areas are used for various military training and operational activities. The potential for multiple-use conflicts resulting from concurrent use of the areas by the military and OCS operators resulted in the development of mitigation measures acceptable to both DOI and DOD.

The military stipulation was developed and has evolved through consultation and coordination between DOI and DOD. The stipulation has proven to be adequate for the needs of both organizations and have promoted effective multiple use of the military areas. Joint use of the OCS by the military and the oil and gas leasing program, without conflict, has been made possible by extensive and continued coordination between DOI and DOD. Both departments have agreed on the mutual importance of their missions and on procedures to deal with any conflicts of joint use should a problem arise. To date, there have been no reported accidents involving conflicts between OCS operations and military activities.

Until recently, multiple-use conflicts in the military areas were thoroughly addressed as major issues of concern in EIS's on Gulf of Mexico lease sales. The leasing program and its relationship with military activities have matured to an extent that potential conflicts are unlikely to result in environmental impacts and is not analyzed as a major issue in this EIS. However, the military stipulation and a discussion of its effects is included in Section II.A.1.c.(4) of this document.

(j) Offshore Marine Recreational Fishing Activities

Recreational fishing activities have historically been found to have a positive impact from oil- and gas-related platforms located within areas accessible to offshore fishermen. Because current leasing has occurred at greater distances from the shore and because there are a great many platforms already accessible to fishermen, it is believed that any new platforms will only have minor incremental benefits. This issue has lost its former significance because extensive and definitive studies off Louisiana and Texas have shown that oil and gas structures attract fish and fishermen and significantly improve recreational fishing. These beneficial effects have been thoroughly analyzed in previous EIS's and, therefore, any conflicts with offshore marine recreational fishing activities will be considered as a minor concern rather than a major issue in this EIS.

(k) Effects of Structure Removal Activities

Several commentors requested a discussion and analysis of the issues associated with the removal of old oil and gas production platforms/facilities. Structure removal is considered an IPF, rather than a major issue, and is addressed in the analysis of impacts on resources in Section IV.A. and again in Section IV.D. in the analysis of the impacts on sea turtles and marine mammals.

(l) Effects of Deepwater Oil and Gas Activities

The State of Louisiana indicated that the EIS should address in detail the concerns and problems that will be encountered as exploration and production move into deeper waters and take into account the associated increased potential for impacts to environmentally sensitive shore areas. As stated above, IPF's are not analyzed as major issues since EIS's focus on the impacted resources as the major issues. The analyses of the impacts on affected resources take into account potential impacts due to the hazards associated with deepwater activities.

3. Regulatory and Administrative Framework

a. Presale Activity Information/Regulations/Coordination

(1) Federal/State Coordination

The DOI has the responsibility to perform certain regulatory and administrative functions during the presale stage. The OCSLA requires the Department to coordinate with State and local governments prior to actual leasing when the states may be affected by oil and gas activities. Specific timeframes are developed during which the Secretary provides information to the states and they, in turn, have opportunities to comment and coordinate with the Secretary.

For a more complete description of this coordination process, see Volume 1, Section I.B.3. of the Final Regional EIS (USDI, MMS, 1983a).

(2) Geological and Geophysical Exploration Regulations/Coordination

Geological and geophysical (G&G) surveys and analyses provide most of the resource and hazards information used by government and industry on the oil and gas potential of offshore areas. The collecting of G&G data begins prior to the leasing of Federal land and continues throughout the term of offshore mineral leases.

Pursuant to 30 CFR 251.4, a permit or notice must be obtained in order to conduct either geological or geophysical exploration for mineral resources or geological or geophysical scientific research of areas of the Gulf OCS, except for a lessee on a lease. "Geological exploration for mineral resources" means any operation conducted on the OCS that uses geological and geochemical techniques, including, but not limited to, core and test drilling, well logging techniques, and various bottom sampling methods to produce information and data on mineral resources, including information and data in support of possible exploration and development activity. "Geophysical exploration for mineral resources" means any operation conducted on the OCS that uses geophysical techniques, including, but not limited to gravity, magnetic, and various seismic methods, to produce information and data in support of possible exploration and development activity. "Geological or geophysical scientific research" means any investigation conducted on the OCS that uses geophysical techniques, including, but not limited to, gravity, magnetic, and various seismic methods to produce information and data in support of possible exploration and development activity (30 CFR 251.2(n), (o), and (p)). A notice is an agreement for scientific research, and the resulting data is made available to the public at the earliest practicable time.

Permit applications for G&G activity must be submitted to MMS in accordance with the requirements outlined in 30 CFR 251.5 and 30 CFR 251.6 and explained further in Letter(s) to Permittees. The regulations under 30 CFR 251 do not apply to G&G exploration activities conducted by or on the behalf of the lessee on a leased block on the Gulf OCS. Geological and geophysical activities by the lessee on his existing leases are governed by the regulations in 30 CFR 250. The Gulf coastal states are not involved in the review process for specific G&G applications prior to issuance of the permit, except for Deep Stratigraphic Tests (DST's). Environmental reports are required in accordance with 30 CFR 251.6-2(6) for DST's, and when required under a coastal zone management program must receive State concurrence prior to approval of any activities covered under the permit. The plan and report is also made available to appropriate Federal agencies and the public in accordance with established practices and procedures. Shallow test drilling or DST's must utilize the best available and safest technologies that the Director of MMS determines to be economically feasible. Additional environmental information may be required for G&G applications proposing the use of solid or liquid explosives. The use of explosives may also lead to initiation by MMS of consultation with NMFS under Section 7 of the Endangered Species Act.

After receiving a G&G permit application, MMS prepares either a categorical exclusion review (CER), environmental assessment (EA), or EIS in accordance with NEPA and other applicable MMS policies and guidelines. A CER is prepared for most G&G permit applications. Activities that include the drilling of DST holes, involve the use of solid or liquid explosives, or that otherwise have the potential to significantly affect the quality of the human environment automatically require the preparation of an EA.

b. Postsale Activity Regulations/Coordination

The MMS is responsible for regulating and monitoring the oil and gas operations on the Federal OCS. The regulations at 30 CFR 250.5 provide for the Director to regulate all operations conducted under a lease or permit and to issue or amend OCS Orders and other rules as may be necessary to supervise operations and to prevent harm or damage to life, property, or the marine, coastal, or human environment or waste of any natural resource. On April 1, 1988, the *Federal Register* (53 FR 10596-10777) published the final rules that restructured and consolidated the rules governing oil, gas, and sulphur exploration, development, and production operations. These rules were effective on May 31, 1988. Prior to either exploration, development, or production activities being conducted in a lease block, other than on-lease preliminary activities, companies must submit plans to MMS for review and approval. Within these plans, specific requirements must be met relative to operating conditions and environmental considerations. The regulations now allow for penetration of the seabed up to 500 ft for on-lease preliminary activities, provided such activities do not result in any significant adverse impact on the natural resources of the OCS (30 CFR 250.31). Prior notification or approval may be required by MMS.

(1) Review, Coordination, and Approval of Exploration, Development, and Production Activities

(a) Exploration Plans

Pursuant to Section 11 of the OCSLA and 30 CFR 250.33, an exploration plan and its supporting information must be submitted for approval to MMS before an operator may begin exploratory drilling on a lease. The plan describes all exploration activities planned by the operator for a specific lease(s), the timing of these activities, information concerning drilling vessels, the location of each well, and other relevant information. A revised plan is a revision to an approved plan that proposes changes such as those in surface location, type of drilling unit, or location of the onshore support base. A supplemental plan constitutes a revision to an approved plan that proposes the additon of an activity that requires a permit. An amended plan is any revision to a pending plan. Each of these types of plans need contain only that information related to or affected by the proposed revision.

The revised rule provides for submission of supporting information for MMS and CZM State evaluation as outlined in 30 CFR 250.33(b)(1) through (21). The operator may limit the amount of information submitted to that which is listed in the Letter to Lessees dated October 12, 1988. Environmental reports are not considered a separate part of the plan. This was intended to eliminate unnecessary duplication. Lessees may, however, continue to submit the necessary information in more than one volume as part of the plan. The MMS can disapprove a plan based on inadequate or inaccurate supporting information, *inter alia*.

The supporting information provides an analysis of both offshore and onshore impacts that may occur as a result of implementation of the plan. In accordance with the Coastal Zone Management Act of 1972 (CZMA), as amended, exploration plans requiring State review must contain a certification of consistency with approved CZM programs of states that could be affected by the exploration activities. States with approved programs may take up to six months for consistency reviews but must agree with or request an extension within three months after receipt of their copy of the plan. In the Gulf of Mexico, Louisiana, Mississippi, Alabama, and Florida have Federally approved CZM programs. The guidelines and environmental information requirements for lessees and operators submitting an exploration plan are discussed further in Section I.B.3.b.(1)(c).

The MMS prepares a CER, EA, or EIS based on available information, which may include the submitted plan, the geophysical report (for determining the potential for the presence of deepwater benthic communities), archaeological report (30 CFR 250.33(b)(15)), air emissions data, live bottom survey/report (30 CFR 250.33(b)(12)), biological monitoring plan (30 CFR 250.33(b)(16)), and recommendations by the affected State(s), the Department of Defense, the U.S. Fish and Wildlife Service (FWS) (for selected plans under provisions of Departmental Manual (DM) 655), NMFS, and/or internal MMS offices. The MMS evaluates the proposed activity for potential impacts relative to geohazards and manmade hazards (including existing pipelines), archaeological resources, endangered species, sensitive biological features, water and air quality, and other uses (e.g., military operations) of the OCS.

The CER's are prepared for certain postlease activities in the WPA, CPA, and western part of the EPA in accordance with Appendix 1 of 516 DM 2 and 516 DM 6, Appendix 10. That western portion of the EPA is offshore the State of Alabama from the CPA/EPA common boundary eastward to the offshore extension of the

Alabama/Florida common boundary for State waters at approximately 87°31' west longitude (consult Visual No. 1 for further details). The criteria used to determine which actions are to be excluded from the NEPA process follow: the action or group of actions would have no significant effect on the quality of the human environment, and the action or group of actions would not involve unresolved conflicts concerning alternative uses of available resources. The CER's do serve as a vehicle for a considerable environmental analysis in cases where archaeological, air quality, and biological assessments are necessary in early planning.

If the CER determines that the proposed action is an exception to the categorical exclusions as listed in 516 DM 2, Appendix 2, then the preparation of an EA is required. An EA may also be prepared on any action at any time in order to assist in planning and decisionmaking (516 DM 3.2.B) or under extraordinary circumstances (516 DM 2.4). EA's are routinely prepared for actions in the Eastern Gulf of Mexico (offshore Florida), for selected environmentally sensitive areas (e.g., for activities proposed within the 4-mile zone of the Flower Garden Banks lease blocks), for proposed activities considered environmentally sensitive (e.g., new or unusual technology and pipeline corridors to shore), and for structure removal operations. Operations proposing the use of explosives may lead to consultation under Section 7 of the Endangered Species Act.

If the EA indicates that approval of the plan would constitute a major Federal action significantly affecting the human environment, and an existing EIS addressing the matter does not exist, an EIS must be prepared. On the basis of the EA, CER, or EIS findings and the plan completeness review, the exploration plan will be either approved or disapproved, or modification of the plan will be required of the operator. The EA will also identify appropriate mitigation of impacts of the proposal.

Other permits required prior to exploratory drilling include permits for aids to navigation from the U.S. Coast Guard (USCG), permits for installation of structures attached to the seabed from the U.S. Army Corps of Engineers (COE), and NPDES permits from USEPA if the plan is not covered under the Gulf of Mexico general NPDES permit.

(b) Development and Production Plans

Development and production plans are not required for leases in the Western Gulf pursuant to 30 CFR 250.34-(d)(1). (In this designation, the Western Gulf includes all areas of the Gulf of Mexico except those that are adjacent to the State of Florida.) However, information covering these leases is required to ensure conformance with the OCSLA, other laws, applicable regulations, and lease provisions and to enable MMS to carry out its functions and responsibilities. Therefore, before any development and production activity is conducted on a lease in the Western Gulf, the operator must prepare and submit to MMS a Development Operations Coordination Document (DOCD), and, as required, supporting environmental information, archaeological report, biological report (monitoring and/or live bottom survey), or other environmental data determined necessary. A DOCD shall be considered a development and production plan for the purpose of any references in any law, regulation, lease provision, agreement, or other document referring to the preparation or submission of a plan. The plan describes a schedule of development activities, platforms, or other facilities including environmental monitoring features, and other relevant information. Refer to Section I.B.3.b.(1)(a) for a discussion of plan revisions. The revised rule provides for submission of supporting information for MMS and State CZM evaluation as outlined in 30 CFR 350.34(b) through (u). As with exploration plans, MMS can disapprove a plan based on inadequate or inaccurate supporting information, *inter alia.*

After receiving the Plan of Development/Production or DOCD, MMS prepares either a CER, EA, or EIS as discussed under Exploration Plans above. As part of the review process, the Plan and supporting environmental information, as required, are sent to the affected state(s) having an approved CZM plan for consistency certification review and comment. Section 19 of the OCSLA provides for coordination and consultation with the affected states and local governments concerning a development plan. The guidelines and environmental information requirements for lessees and operators submitting a development and production plan are addressed in NTL 86-09 and are discussed further in Section I.B.3.b.(1)(c). On the basis of the CER, EA, or EIS findings and the plan completeness review, the development/production plan will either be approved or disapproved, or modification of the plan will be required of the operator.

After the approval of the plan, the operator submits specific applications to MMS, such as those for pipelines and platforms, to conduct activities described in the plan. Additional applications submitted for approval to various Federal agencies include those to the USCG for aids to navigation, COE for navigation and platform installation permits, and USEPA for NPDES permits if the plan is not covered under the Gulf of Mexico general NPDES permit.

(c) Oil Spill Contingency Plans

Pursuant to 30 CFR 250.42, all lessees are required to submit for approval an Oil Spill Contingency Plan (OSCP). No permits to conduct operations are approved by MMS unless the lessee has an approved OSCP. All OSCP's are reviewed and updated annually. The plan must contain assurances that a full response capability exists for commitment in the event of an oil spill. Such a commitment includes specification of appropriate equipment and materials, their availability and deployment time, and provisions for varying degrees of response effort, depending on the severity of the spill. Refer to Secton IV.B.4.a. for additional information on oil spill planning.

(d) Hydrogen Sulfide Contingency Plans

A Hydrogen Sulfide (H_2S) Contingency Plan must be submitted for approval prior to operations on a lease, and must include contingencies for simultaneous drilling, well-completion, well-workover, and production operations. The lessee must take all necessary and practicable precautions to protect personnel from the toxic effects of H_2S and to mitigate the adverse effects of H_2S to property and the environment. The specific requirements concerning H_2S are not applicable to operations in zones where the absence of the gas has been confirmed. This includes geologic formations where prior drilling operations or logging, coring, testing, or producing operations have indicated that H_2S bearing zones have not been encountered that could potentially result in atmospheric concentrations of 20 ppm or more of H_2S.

(e) Environmental Information

Pursuant to 30 CFR 250.33 and 250.34, specific environmental information, as discussed in Sections I, II, and IV of NTL 86-09 and prepared in accordance with guidelines in Sections II.A., II.B., or III of the enclosure to NTL 86-09, is required for leases in the Gulf of Mexico for CZM purposes. It should be noted that the term "environmental report" as used in NTL 86-09 is synonymous with the term "environmental information" required by the Letter to Lessees dated October 12, 1988. Under the CZMA, each state that has an approved CZM plan has the option to require information that is different than that specifically outlined in 30 CFR 250.33 and CFR 250.34 for inclusion in the plan. The States of Louisiana, Mississippi, Alabama, and Florida have approved CZM programs. With the exception of Florida, abbreviated environmental information is submitted by operators for CZM purposes. Requirements for both the abbreviated format required for the States of Alabama, Louisiana, and Mississippi and the long-form format required for activity determined to affect the State of Florida are given in the Letter to Lessees dated October 12, 1988 (NTL 86-09 incorporated therein by reference). The operating regulations, effective May 31, 1988, recognize the possible significance of proposed modifications to approved plans and provide for CZM agency review of modifications.

Additional environmental information may also be required for plans/activities in the Western Gulf of Mexico for the following: (1) areas of high seismic risk or seismicity and relatively untested deepwater and remote areas; (2) areas proposed or established as a marine sanctuary and/or near the boundary of a proposed or established wildlife refuge or areas of high ecological sensitivity (e.g., Flower Garden Banks); (3) areas of potentially hazardous natural bottom conditions; or (4) the use of new or unusual technology, when the additional information is required to evaluate impacts. Environmental information requirements will be determined on a case-by-case basis for plans meeting any of the four categories, with the exception of plans submitted that propose activities within the restrictive zones of the Flower Garden Banks. The guidelines enclosure of NTL 86-09 outlines the information requirements for activities proposed within the 4-mile zone of the Flower Garden Banks. Specific information is required for structure removal applications as outlined in Letters to Lessees dated August 19 and December 9, 1986. The submission of specific supporting information to aid in evaluating the environmental impacts of plans/activities may be required by MMS under 30 CFR 250.33-(b)(21) and 30 CFR 250.34-(b)(15) in areas of the Central and Western Gulf where either no environmental information is required or an abbreviated format is required for CZM purposes.

(f) Air Emissions Information

Section 5(a)(8) of the OCSLA provides that the Secretary shall promulgate and administer regulations to provide for compliance with the National Ambient Air Quality Standards (NAAQS) pursuant to the Clean Air Act. This is accomplished through 30 CFR 250.44 and 30 CFR 250.45 and administered by MMS as a postsale activity. It is the intent of 30 CFR 250.44 and 30 CFR 250.45 to protect onshore ambient air quality and to ensure that no new violations of the NAAQS are caused by the OCS activity. The criteria pollutants that are regulated are carbon monoxide, total suspended particulates, sulphur dioxide, nitrogen oxides, and volatile organic compounds. Emissions data concerning new or modified onshore facilities (directly associated with offshore activities) are required to enable each affected state to make a determination of the effects on its air quality.

Plans of exploration, plans of development and production (Eastern Gulf of Mexico), and DOCD's have been determined by the Secretary as activities regulated under 30 CFR 250.44 and 30 CFR 250.45. All new or supplemental exploration, development and production plans, and DOCD's submitted on or after June 2, 1980, must include air emissions information sufficient to make an air quality determination. The Letter to Lessees dated October 12, 1988, outlines air emissions data that may be submitted by operators.

(g) OCS Structures

(1) Wells

The lessee is required to take precautions to keep exploratory well drilling under control at all times. An Application for Permit to Drill (APD) is filed by the lessee/operator along with or following submission of the Exploration Plan and supporting information. The APD requires detailed information about the drilling program for evaluation with respect to operational safety and pollution prevention measures. Approval of an APD requires an MMS-approved Exploration Plan and receipt of CZM consistency or presumptive concurrence. The approved APD constitutes the drilling permit. The APD is reviewed for conformance to the requirements of 30 CFR 250.64 and other engineering considerations. The lessee is required, as part of the APD, to submit form MMS-331C prior to commencing operations. In addition, other information including project layout at a scale of 2,000 ft to the inch, design criteria for well control and casing, blowout preventors, a mud program, and an H_2S contingency plan is required. The lessee must utilize the best available and safety technology in order to enhance the evaluation of abnormal pressure conditions and to minimize the potential for uncontrolled well flow. Specific requirements for well workovers, completions, abandonments, and sundry notices are detailed in Subparts D-G of the revised regulations. Significant deviations from an approved plan require that an environmental analysis be done in accordance with the procedures outlined in Section I.B.3.b.(1)(a).

(2) Platforms

The lessee must design, fabricate, install, use, inspect, and maintain all platforms and structures on the OCS to assure their structural integrity for the safe conduct of operations at specific locations. A program has been established by MMS for new platforms meeting the criteria at 30 CFR 250.130(c) that is designed to assure that offshore oil and gas structures are designed, fabricated, and installed using standardized procedures to prevent structural failures. Lessees are required to submit detailed information on any proposed structure to be erected. The program facilitates review of these structures and utilizes third party expertise and technical input in the verification process through the use of a Certified Verification Agent. The lessee evaluates characteristic environmental conditions associated with operational functions to be performed. Factors such as waves, wind, currents, tides, temperature, and the potential for marine growth are considered. An environmental analysis would be conducted for any proposal involving the use of new or unusual technology in accordance with the procedures outlined in Section I.B.3.b.(1)(a).

(3) Production Facilities

Production safety equipment used on the OCS must be designed, installed, used, maintained, and tested in a manner to assure the safety and protection of the human, marine, and coastal environments. All tubing installations open to hydrocarbon-bearing zones below the surface must be equipped with safety devices that will shut off the flow from the well in the event of an emergency, unless the well is incapable of flowing. All surface production facilities, including separators, treaters, compressors, headers, and flowlines, must be designed, installed, and maintained in a manner that provides for efficiency, safety of operations, and protection of the environment. Surface and subsurface controlled safety valves and locks must conform to the requirements of 30 CFR 250.126. Production facilities also have stringent requirements concerning electrical systems, flowlines, engines, and firefighting systems. The safety system devices are tested by the lessee at specified intervals and must be in accordance with API RP 14 C, Appendix D, and other measures.

(4) Pipelines

The DOI's exclusive jurisdiction with respect to pipeline activities extends upstream from the outlet flange at each facility where produced hydrocarbons are first separated, dehydrated, or otherwise processed to each production well in the OCS. In addition, those pipelines necessary for the development of a lease are under DOI's exclusive jurisdiction.

The MMS pipeline permit applications are filed under Subpart J of 30 CFR 250. Detailed requirements for filing the applications are found at 30 CFR 250.157 and 30 CFR 250.160. Normally, each permit application will contain the pipeline location drawing, profile drawing, safety schematic drawing, and the pipe design data to scale. Information submitted as part of the shallow hazard survey report/analysis and/or archaeological report is used for MMS environmental evaluations. Provisions governing offshore pipelines under the revised rulemaking include expanded requirements governing design, installation, testing, safety equipment, abandonment, and reporting. In considering applications for pipeline permits, MMS approves the design and fabrication of the pipeline and prepares a CER, EA, or EIS in accordance with applicable policies and guidelines. The MMS prepares an EA or EIS on all pipeline corridors that go ashore (516 DM 6, Appendix 10). Pipelines directly affecting the coastal zone of a state with an approved CZM program may not be approved unless they are consistent with the approved CZM program. The FWS reviews and provides comments on applications for pipelines that are near sensitive biological features or that cross into State waters. The MMS inspects pipeline routes for an indication of pipeline leakage. Pipelines may be abandoned in place if they do not constitute a hazard to navigation and commercial fishing or unduly interfere with other uses of the OCS. Procedures for pipeline abandonment and reporting are outlined in detail at 30 CFR 250.156 and 30 CFR 250.158.

(h) Site Clearance

The lessee must verify site clearance after abandonment through one of the methods given at 30 CFR 250.114 and 30 CFR 250.143. Certification that an area is cleared of all obstructions must be submitted on Form MMS-332 for exploratory operations and by means of a company letter for development structures. Pipeline abandonment is discussed in detail at 30 CFR 250.156.

The use of explosives to cut offshore oil/gas structure legs/pilings for removal could cause injury or death to protected marine mammals and endangered sea turtles. Lessees/operators must notify MMS 30 days before a structure removal and provide information including the following: complete identification of structure, size of structure (number and size of legs and pilings), removal technique to be employed, if explosives are to be used the amount and type of explosive per charge, and number and size of well conductors to be removed and removal technique (see Letters-to-Lessees dated August 19 and December 9, 1986). Each structure removal request is reviewed on a case-by-case basis. Currently, if a structure removal involves the use of explosives, an environmental assessment is prepared and an Endangered Species Section 7 Consultation is initiated with NMFS. The NMFS issued a "standard" Biological Opinion on July 25, 1988, which covers removal operations that meet specified criteria pertaining to the size of explosive charge used, detonation depth, and number of blasts per structure grouping. The MMS, NMFS, and lessees are cooperating in an observer/monitoring program to determine the presence of protected marine mammals and/or endangered sea turtles in the vicinity of the structure removals.

(2) *Enforcement Measures*

(a) *Inspections*

Drilling and production compliance inspections are conducted before, during, and after operations to assure compliance with lease terms, NTL's, and approved plans and to assure that safety and pollution-prevention requirements of regulations are met. These inspections also involve additional items of environmental concern. Further information on the baseline for the inspection of lessee operations and facilities can be found in the National Potential Incident of Noncompliance (PINC) List (USDI, MMS, 1988a). Noncompliance with checklisted requirements for specific installations or procedures is followed by prescribed enforcement actions, consisting of written warnings or shut-ins of platforms, zones (well), equipment, or pipelines. In some cases, more than one enforcement action is noted. The MMS inspector then determines the appropriate enforcement action based on an assessment of the risk of either pollution or accident, the history of the lessee, the stage of operation in progress, and the status of other systems. The MMS conducted 8,326 inspections in the Gulf during FY 88.

The primary objective of initial inspections is to assure proper installation of mobile units or structures and associated equipment. After operations begin, additional unannounced inspections are held. Depending on the distance from shore, MMS district personnel will visit and inspect from one to three different rigs or platforms per day. Aerial surveillance of additional offshore structures is conducted enroute. Annual inspections are conducted on all platforms. More frequent inspections may be conducted on a few platforms. On-board inspections also involve the inspection of all safety systems of a production platform.

The operator will normally request the use of oil-based muds at the APD stage if problems are anticipated or if problems are encountered during drilling. Approval is granted with the understanding that the cuttings will be collected and transported to shore for disposal. Inspectors try to visit operations using oil-based muds frequently or at least make an effort to "fly-by" when in the area. Of initial importance to inspectors is the presence or absence of a "visible sheen" in the waters adjacent to a rig using oil-based muds or a platform producing hydrocarbons. On-board inspection involves seeing that the muds and cuttings are being properly treated and/or disposed of. The "bucket test" involves dropping 2-3 handfuls of cuttings into a bucket of seawater to test for residual oil. The presence or absence of a "visible sheen" in the bucket determines whether or not the cuttings are being properly treated prior to being dumped. This sheen test, performed by MMS inspectors, is different than the "visible sheen" test required under USEPA's NPDES general permit for the Gulf of Mexico as discussed in Section I.B.5.

District personnel inspect H_2S sensors to make sure that they are operational and inspect logs for timely calibration of instruments and to ensure that rig personnel have been trained in appropriate equipment handling, safety regulations, and emergency procedures. The revised rule for H_2S protection requirements and procedures have been expanded to include production, well completion, and well workover operations as well as drilling operations. Hydrogen sulfide represents a threat to human life and safety and to the survival of equipment.

(b) *Suspension of Operations*

Section 5(a) of the OCSLA and regulations appearing in 30 CFR 250.10 provide for the suspension or temporary prohibition of an operation or activity when the suspension is in the national interest and when the suspension is necessary based on any of the conditions given at 30 CFR 250.10(a) through (k).

(c) *Cancellation of Leases*

The Secretary may cancel a lease or permit if, after opportunity and notice for a hearing, he determines: (1) that continued activity would probably cause serious harm or damage to life, to property, the environment, or national security or defense; (2) that the threat of harm or damage will not disappear or decrease to an acceptable extent within a reasonable time; (3) the advantages of cancellation outweigh the advantages of continued activity; and (4) the suspension has been in effect for at least 5 years, or the termination of suspension and lease cancellation are at the request of the lessee.

(d) Remedies and Penalties

Under Section 24 of the OCSLA and regulations appearing at 30 CFR 250.200-.206, civil penalties can be assessed for failure to comply with responsibilities under the law, a license, a permit, or any regulation or order issued pursuant to the Act. Further, under Section 5 of the OCSLA, the issuance and continuance in effect of any lease or of any assignment or other transfer of any lease shall be conditioned upon compliance with regulations issued under the OCSLA.

(3) Environmental Safeguards

(a) OCS Regulations

On April 1, 1988, revised regulations (30 CFR 250 and 256) were published in the *Federal Register* that restructured and consolidated the rules governing OCS exploration, development, and production activities. These rules were effective May 31, 1988. The former Gulf of Mexico OCS Orders, which dealt with the technical aspects of OCS activities, have been incorporated into the new rules (with the exception of OCS Order No. 10, which concerns sulphur operations) (53 FR 10596-10777).

(1) Approvals

The Director, MMS, is authorized to act upon the requests, applications, and notices submitted to the agency to issue either written or oral orders to govern lease and right-of-way operations, and to require compliance with applicable laws, regulations, and lease terms so that all operations conform to sound conservation practice and are conducted in a manner that will preserve, protect, and develop mineral resources of the OCS.

(2) Best Available and Safest Technologies

To assure that oil and gas exploration, development, and production activities on the OCS are conducted in a safe and pollution-free manner, Section 21(b) of the OCSLA, as amended, requires that all OCS technologies and operations use the best available and safest technology (BAST) that the Secretary determines to be economically feasible. Conformance to the standards, codes, and practices referenced in 30 CFR 250 are considered to be the application of BAST. These include requirements for state-of-the-art drilling technology, production safety systems, completion of oil and gas wells, oil spill contingency plans, pollution control equipment, and specifications for platform/structure designs. MMS conducts periodic offshore inspections; and the Rules, Orders, and Standards section continuously and systematically reviews OCS technologies to insure that the best available and safest technologies are applied to OCS operations. BAST is not required when the Secretary determines that the incremental benefits are clearly insufficient to justify increased costs (30 CFR 250.5(b)); however, it is the responsibility of an operator on an existing operation to demonstrate why application of a new technology would not be feasible. This requirement is applicable to equipment and procedures that, if failed, would have a significant effect on safety, health, or the environment, unless benefits clearly do not justify the cost.

The BAST concept is addressed in the Gulf of Mexico OCS Region by a continuous effort to locate and evaluate the latest technologies and to report on these advances at periodic Regional Operations Technology Assessment Committee (ROTAC) Meetings. A part of the MMS staff has an ongoing function to evaluate various vendors and industry representatives' innovations and improvements in techniques, tools, equipment, procedures, and technologies applicable to oil and gas operations (drilling, producing, completion, and workover operations). This information is provided to MMS district personnel at ROTAC meetings. The requirement for the use of BAST has, for the most part, been an evolutionary process whereby advances in equipment, technologies, and procedures have been subtly integrated into OCS operations over a period of time. An awareness by both MMS inspectors and the OCS operators of the most advanced equipment and technologies has resulted in the incorporation of these advances into day-to-day operations. An example of such an equipment change that evolved over a period of time would be the upgrading of diverter systems on drilling rigs from the smaller diameter systems of the past to the large diameter, high capacity systems found on drilling rigs operating on the OCS today. Another example of a BAST-required equipment change would be the requirement to replace subsurface-controlled safety valves with surface controlled subsurface safety valve systems which incorporate a more positive closure design and operation.

Also, a quality assurance and performance of safety and pollution-prevention equipment program regarding the surface and subsurface safety valves has been included in MMS requirements.

(b) Lease Stipulations

Oil and gas exploration and development activities on the OCS have the potential for causing adverse environmental impacts; therefore, stipulations are developed before the sale (discussed under Sections II and IV in this document) and are attached to the lease instrument, as necessary, in the form of additional mitigating measures. Biological, archaeological resources, and military areas stipulations are those that have been attached most often to the leases in previous Gulf lease sales. The MMS is responsible for ensuring full compliance with stipulations appended to leases.

(c) Other Environmental Safety Controls

Besides its regulations and lease stipulations, MMS has two mechanisms that may be used to control or mitigate environmental or safety problems that may arise. In addition, conditions that may be necessary to provide environmental protection may be applied to any permit, right-of-use, or easement.

(1) Notices, Letters, and Information to Lessees and Operators

Notices to Lessees and Operators (NTL's) are formal documents that provide clarification, description, or interpretation of a regulation, OCS Order or Standard; provide guidelines on the implementation of a special lease stipulation or regional requirement; provide a better understanding of the scope and meaning of a regulation by explaining MMS interpretation of a requirement; or transmit administrative information such as current telephone listings, a change in MMS personnel, or office address. A detailed listing of current and effective Gulf of Mexico NTL's was published in the *Federal Register* on July 9, 1987 (52 FR 25925-25926). The MMS will publish an updated NTL listing annually in the *Federal Register*.

The MMS also conveys important information by way of "Letters to Lessees and Operators (LTL's)" and "Information to Lessees and Operators (ITL's)." These documents further clarify or supplement operational guidelines. Separate Regional mailings and the EIS process have served as the vehicle for communicating previous NTL's, LTL's, and ITL's that have been issued.

(2) Mitigating Measures/Conditions of Approval

Mitigating measures and conditions of plan approval are two mechanisms used by MMS to control or mitigate potential environmental or safety problems associated with a proposal. These mechanisms represent an integration of review results from other Federal and State agencies (as applicable) and MMS technical evaluations (including geological and geophysical; royalty, Suspension of Production schedule, and competitive reservoir considerations; potentially hazardous situations involving existing or proposed pipelines; conflicts with archaeological resources and sensitive biological areas, and other uses; NEPA compliance; and plan completeness).

Alternatives to a proposed action are evaluated as part of the NEPA process to assess reasonable alternative activities that could result in less risk of adverse environmental impacts. In addition to alternatives proposed by the lessee/applicant, alternatives that consider other uses of resources that involve unresolved conflict, and alternatives or mitigation that are not part of the proposal that may be needed to minimize environmental effects are given full consideration. Mitigating measures have addressed resource use concerns such as endangered/threatened species, geologic and manmade hazards, military warning and ordnance disposal areas, oil spill contingency planning, chemosynthetic communities, operations in H_2S prone areas, and shunting of drill effluents in the vicinity of biologically sensitive features.

Conditions that may be necessary to provide environmental protection may be applied to any permit, right of use, or easement. Final action on OCS plans includes approval, disapproval, or modification.

(3) *Personnel Training and Education*

An important factor in ensuring that offshore oil and gas operations are carried out in a manner that emphasizes operational safety and minimizes the risk of environmental damage is the proper training of personnel. Under 30 CFR 250.43, all companies must have trained personnel to operate oil spill cleanup equipment or must have retained a trained contractor(s) that will operate the equipment for them. The Drilling Well-Control Training Program, now incorporated under 30 CFR 250.210-250.212, was instituted by MMS in 1979. In 1982 and 1983, an additional training program--the Safety Device Training Program--was developed and put into effect. The Safety Device Training Program, incorporated under 30 CFR 250.210-250.212, ensures that personnel involved in installing, inspecting, testing, and maintaining safety devices are qualified.

(d) *Compensation for Spill Cleanup and Damage*

(1) *Offshore Oil Pollution Compensation Fund (33 CFR 135)*

Title III of the OCSLA, as amended, provides an offshore oil spill liability fund for actual costs of oil removal and cleanup, as well as replacement or restoration costs of natural resources damaged or destroyed by a spill. The OCSLA, as amended, establishes a fund in the U.S. Treasury not to exceed $200 million that is administered by the Departments of Transportation and Treasury. The fund is generated by fees on OCS-produced oil (3 cents per barrel produced) and recompensed by claims against liable operators or owners. The fund covers spills from any offshore facilities on the OCS and any tanker, barge, or other water craft operating in offshore waters and carrying oil directly from an offshore facility. Except for willful misconduct or gross negligence, total liability is limited to $250,000 or $300 per gross tonnage for a vessel, and $35 million plus removal and cleanup costs for an offshore facility. The fund can be used to back up the "revolving" fund described below and for third party claims.

(2) *U.S. Coast Guard's Pollution Revolving Fund*

The FWPCA, as amended, provides for a $35 million contingency fund for the removal and cleanup of oil from waters of the United States when the discharger is unknown or his cleanup actions are inadequate. This oil spill liability fund is administered by USCG (33 CFR 153). Under the law, a known discharger, may be responsible for reimbursing the fund for actual costs incurred. Penalties collected for violation of the FWPCA's Section 317 are placed back into the fund; thus, the fund is said to be "revolving."

(3) *Fishermen's Contingency Fund (30 CFR 296)*

Title IV of the OCSLA, as amended, established this fund (not to exceed $2 million) to compensate commercial fishermen for actual and consequential damages including loss of profit due to damage or loss of fishing gear by various materials and items associated with oil and gas exploration, development, or production on the OCS.

This fund is administered by the Financial Services Division, National Marine Fisheries Service, NOAA. It should mitigate most losses suffered by commercial fishermen due to OCS oil and gas activities.

4. Other Federal Agency Regulatory/Administrative Measures

a. Navigation

Responsibilities for regulating navigation on the OCS are shared by USCG, the Federal Aviation Administration (FAA), and U.S. Army Corps of Engineers (COE). A detailed description of these responsibilities may be found in Section I.B.4.a. of Final EIS 81/84. The Ports and Waterways Safety Act (PWSA) (33 U.S.C. 1221 et seq.) authorizes the USCG to designate necessary fairways, traffic separation schemes (TSS's), and anchorages for vessels operating offshore; it recognizes, with some limitations within fairways, the paramount right of navigation over all other uses. Safety fairways are areas in which no fixed structures are permitted and, therefore, fairways may inhibit exploration and development of mineral resources in the area so designated. The PWSA requires that the USCG consult with DOI to reconcile the need for safe access routes with the needs of all other reasonable uses of the area involved. Lessees are advised that the USCG may designate necessary fairways through leased blocks pursuant to the PWSA (33 U.S.C. 1221 et seq.).

Responsibility for permitting mobile drilling units (MODU's), fixed structures, and pipelines is covered by the nationwide COE permit program provision (33 CFR 330.5(a)(8)) provided they are not located within the limits of any designated shipping fairway or traffic separation scheme. On October 5, 1984, COE published the final rule on "Regulations for Controlling Certain Activities in Waters of the U.S." in the *Federal Register* (49 FR 39478). The major effect of the new rule is to establish reporting requirements and procedures.

b. OCS Pipelines

Regulatory processes and jurisdictional limitations concerning pipelines on the OCS and in coastal areas are shared by several Federal agencies (DOI, DOT, FERC, COE, and USCG) as shown in Volume 1, Section I.B.4.b. of the Final Regional EIS. Aside from pipeline regulations, these agencies have the responsibility of overseeing and regulating the following areas: the placement of structures on the OCS and pipelines in areas that affect navigation; the certification of proposed projects involving the transportation or sale of interstate natural gas, including OCS gas; the right of eminent domain exercised by pipeline companies; and wellhead pricing controls for certain gas produced on the OCS. In addition, the Materials Transportation Bureau is responsible for promulgating and enforcing safety regulations for the transportation in or affecting interstate commerce of natural gas, liquefied natural gas (LNG), and hazardous liquids by pipeline. This includes all offshore pipelines on State lands beneath navigable waters and on the OCS. The regulations are contained in 49 CFR 191-193 and 195.

There is a Memorandum of Understanding (MOU) between the Department of Transportation (DOT) and DOI, which gives recognition to each party's respective regulatory responsibilities. Basically, DOT is responsible for establishing and enforcing design, construction, operation, and maintenance regulations for pipelines extending to the shore from the outlet flange of an offshore facility. DOI responsibility extends upstream from the outlet flange.

c. Coastal Zone Management

As a result of the interface between coastal resources and land use conflicts, the CZMA (16 U.S.C. 1451-1464) was enacted. The Act is administered by the Office of Ocean and Coastal Resource Management (OCRM), which was formerly named the Office of Coastal Zone Management and which is under National Ocean Service of the National Oceanic and Atmospheric Administration (NOAA) within the Department of Commerce (DOC). The CZMA sets major goals for the protection of natural, historic, and archaeological resources, and it provides for increased recreational access, the management of coastal development, and the coordination and streamlining of Federal and State decisions directly affecting the coastal resources. A Federal action directly affecting the coastal zone must be consistent with an affected coastal state's Federally approved coastal management plan. If a serious consistency disagreement arises, mediation can be undertaken with the Secretary of Commerce.

The Act also provides Congress the opportunity to provide aid to the states in the form of grants. Section 305 authorizes grants for development of management programs for land and water resources in the coastal zone. Section 306 authorizes grants of not more than 80% of the program's administrative costs. Section 307 deals with interagency coordination and cooperation.

Of the four states affected by these sales, only Texas does not have an approved CZM plan; however, the State does have agencies such as the Air Control Board, Parks and Wildlife, Department of Water Resources, Health Department (marine life), General Land Office (environmental protection), and the Railroad Commission (regulation of oil and gas activities) that have the responsibility of managing the various resources.

No new CEIP funds have been allocated by Congress since FY 81. Funding under the CZMA currently is $2,000,000 (Section 306 grant) for Florida; $601,000 (Section 306 grant) for Alabama; $544,000 (Section 306/306A grant) for Mississippi; $2,000,000 (Supplemental 306 grant) for Louisiana; and $204,000 (Section 309 award) to the Tri-State Group composed of Florida, Alabama, and Mississippi for losses associated with hurricane events and hurricane planning.

d. Archaeological Resources Legislation

The Federal Government's involvement in archaeological resource management and protection on the OCS is based on the requirements of the National Historic Preservation Act of 1966, as amended, which states, in effect, that any Federal agency, before approving Federally permitted or Federally funded undertakings, must take into consideration the effect of that undertaking on any property listed on, or eligible for, the National Register of Historic Places. Implied in this legislation and Executive Order 11593 is that an effort be made to locate such sites before development of an area. Section 11(g)(3) of the OCSLA, as amended, states that "such exploration (oil and gas) will not . . . disturb any site, structure, or object of historical or archaeological significance."

e. Endangered Species Act of 1973

The Endangered Species Act of 1973 (16 U.S.C. 1531-1543, 50 CFR 17), as amended, is administered by FWS and NMFS, and it establishes a national policy designed to protect and conserve endangered and threatened species and the ecosystem upon which they depend. Section 7 of the Act, governing interagency cooperation, provides for Federal agencies to consult with FWS and NMFS to ensure that their actions do not jeopardize the continued existence of an endangered or threatened species and/or result in adverse modification or destruction of their critical habitat.

f. Marine Mammal Protection Act of 1972

The Marine Mammal Protection Act of 1972 (16 U.S.C. 1361-1407; 86 Stat. 1027, 1972; 95 Stat. 979, 1981), as amended, establishes a national policy designed to protect and conserve marine mammals and their habitats. Authority for administering the Act has been delegated to NMFS, which is responsible for all cetaceans and pinnipeds (except walrus), and FWS, which is responsible for walrus, sea otters, manatees, and dugongs. The Act specifically prohibits the harassing, hunting, capturing, or killing of any marine mammal unless otherwise exempted under provisions of the Act. The Marine Mammal Commission is responsible for advising Federal agencies on the protection and conservation of marine mammals. The Commission has a Committee of Scientific Advisors, which provides advice on actions needed to fulfill the purposes of the Act.

g. Fishery Conservation and Management Act of 1976

The Fishery Conservation and Management Act of 1976 (FCMA) (16 U.S.C. 1801-1882) established a fisheries conservation zone for the United States and its possessions and delineates an area from the States' seaward boundary out 200 nmi. The Act created eight Regional Fisheries Management Councils (FMC) and mandated a continuing planning program by the Councils. As a part of this program, a Fishery Management Plan (FMP) must be prepared for each species (or related group of species) of fish harvested within each respective region. The Act, as amended, requires that a FMP based upon the best available scientific and economic data be prepared for each commercial species (or related group of species) of fish that is in need of conservation and management within each respective region.

To date, eight FMP's have been implemented by the Gulf of Mexico FMC. The FMP for shrimp was implemented in 1981; for stone crab, in 1982; for spiny lobster, in 1982; for coastal pelagics, in 1983; for coral, in 1984; for reef fish, in 1984; for swordfish, in 1985; and for red drum, in 1987. The FMP's are amended and updated as new information from studies and public input is received and assessed.

For a detailed description of the Fishery Conservation and Management Act of 1976, see Volume 1, Section I.B.4.g. of the Final Regional EIS (USDI, MMS, 1983a).

h. National Fishing Enhancement Act of 1984

Title II of Public Law 98-623, also known as the Artificial Reef Act, establishes broad artificial reef development standards and a National policy of the United States to encourage the development of artificial reefs that will enhance fishery resources and commercial and recreational fishing. The Secretary of Commerce provided leadership in developing a National Artificial Reef Plan that identifies design, construction, siting, and maintenance criteria for artificial reefs and provides a synopsis of existing information and future research needs on artificial reefs. The Secretary of the Army issues permits to responsible applicants for reef development projects in accordance with the National Plan, as well as Regional, State, and local criteria and plans. The law also limits the liability of reef developers complying with permit requirements and amends the Reefs for Marine Life Conservation Law to include the availability of all surplus Federal ships for consideration as reef development materials.

Although the Act mentions no specific materials other than ships for use in reef development projects, the Secretary of the Interior cooperated with the Secretary of Commerce in developing the National Plan, which identifies oil and gas structures as acceptable materials of opportunity for artificial reef development. The MMS adopted a Rigs-to-Reefs policy in 1985 in response to this Act and to broaden interest in the use of petroleum platforms as artificial reefs.

i. Federal Water Pollution Control Act (Clean Water Act)

The Federal Water Pollution Control Act of 1972 (33 U.S.C. 1251 et seq.), as amended (FWPCA), and commonly called the Clean Water Act, provides a major tool to the Federal Government to ensure that the chemical, physical, and biological integrity of the Nation's waters are maintained. The Act provides a comprehensive plan for dealing with oil spills and discharges of oil and oil-containing substances into Gulf waters in connection with activities under the OCSLA, as amended. The FWPCA addresses spill prevention and control, spilled oil response and removal, and determination of liability and compensation for damage resulting from spills. The Water Quality Act of 1987 expands and strengthens the FWPCA (Clean Water Act) by building on progress already made in water quality and by addressing new and remaining problems. It focuses on these problems to restore and maintain our waters by structuring new programs and legislating these activities to achieve beneficial environmental results.

There are other important acts under which regulations have been promulgated to minimize pollution incidents and the potential environmental and economic damage caused by the release of pollutants from various sources to Gulf waters. These include the OCSLA, as amended; the Ports and Waterways Safety Act; and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), or "Superfund," as amended by the Superfund Amendments and Reauthorizations Act of 1986 (SARA).

National Pollutant Discharge Elimination System

Title III of the FWPCA requires USEPA to establish national effluent limitation standards that reflect the application of "best practical control technology currently available" for existing point sources of wastewater discharges. Section 311 of the Act, as amended, prohibits the discharge of oil or hazardous substances, which may affect the natural resources, into the waters under United States jurisdiction, except under limited circumstances. Title IV of the Act establishes requirements for Federal permits and licenses to conduct an activity (including construction or operation of facilities) that may result in any discharges into waters. Section 402 of the Act confers authority upon USEPA to issue permits for the discharge of pollutants under certain conditons.

On July 9, 1986, USEPA issued a National Pollutant Discharge Elimination System (NPDES) general permit for the Gulf of Mexico. This general permit establishes effluent limitations, prohibitions, reporting requirements, and other conditions on discharges from oil and gas facilities on the OCS (beyond the territorial sea boundary). Section IV.A.3.a.(1) describes the permit requirements in more detail.

Spill Prevention Control and Countermeasure Plans

Onshore support facilities, including oil storage areas of specific capacities, must have approved Spill Prevention Control and Countermeasure (SPCC) Plans prepared by the owners or operators of affected facilities. Guidelines for the preparation of these plans are provided by USEPA (40 CFR 112) and were established by Section 311(g)(1)(c) of the FWPCA.

National Oil and Hazardous Substance Pollution Contingency Plan

To implement the FWPCA, the President's Council on Environmental Quality developed the National Oil and Hazardous Substances Pollution Contingency Plan. This plan is commonly called the National Contingency Plan (NCP). The purpose of the plan is to provide for a coordinated and integrated response by agencies of the Federal Government to protect the environment from damaging effects of pollution discharges. The actual objectives of the plan are to provide for efficient, coordinated, and effective action to minimize damage from oil, including containment, dispersal, and removal. Provisions to accomplish these objectives include (1) assignment of duties and responsibilities among Federal agencies in coordination with State and local agencies; (2) identification, procurement, maintenance, and storage of equipment and supplies; (3) establishment or designation of a strike force to provide necessary services to carry out the plan and the establishment, at major ports, of trained and equipped emergency task forces; (4) a system of surveillance and reporting designed to ensure the earliest possible notice of discharges of oil to the appropriate Federal agency; (5) establishment of a national center to provide coordination and direction for operations in carrying out the NCP; (6) procedures and techniques to be employed in identifying, containing, dispersing, and removing oil; (7) a schedule, prepared in cooperation with the states, identifying dispersants and other chemicals, if any, that may be used in carrying out the NCP; (8) a system whereby the affected state(s) may be reimbursed for reasonable costs incurred in the removal of spills; (9) a procedure for coordinating scientific support of cleanup operations, assessment of damage after a spill, and research efforts; and (10) a system for referral and appeal of decisions of the Regional Response Teams and On-Scene Coordinators (OSC's).

The FWPCA establishes USEPA and USCG as enforcing agencies. These agencies have the authority to marshall the nation's capability to combat an oil spill and share the responsibility to chair the Regional Response Teams established under the NCP. For spills in coastal and offshore waters, the USCG Captains-of-the-Ports serve as the OSC's. For further information about contingency planning, see Section IV.B.4.a. The Coast Guard's Gulf Strike Team, based at Mobile, Alabama, is equipped with current state-of-the-art equipment designed to contain and cleanup oil in the open ocean. The strike team has the capability to deploy equipment and personnel within hours of notification of a spill.

Oil Spill Cleanup

The Clean Water Act (33 U.S.C. 1251) provides a comprehensive plan to limit and distribute liability for oil spill costs. It authorizes the Federal Government to remove oil spilled from a vessel and to recover cleanup costs up to specified limits. The operator or owner is strictly liable for the cleanup costs up to $150 per gross tonnage or $250,000, whichever is greater. In the case of a discharge from an offshore facility, the owner or operator is liable for actual cost incurred during cleanup or for a maximum amount of $50,000,000. If the vessel owner can show that the discharge was caused by one or more of the specified exemptions (namely, an act of God, an act of war, negligence of the Federal Government or a third party), the owner or operator is exempt from any liability for the cleanup costs incurred by the Federal Government. On the other hand, if the Government can prove the discharge was caused by "willful negligence" within the privity of the vessel owner, the owner or operator is liable for the full amount of the Federal Government's cleanup cost. The Federal Maritime Commission determines financial responsibility and also determines if a spiller can meet the liability (46 CFR 542).

The OSC must ensure that the party responsible for the spill is aware of his obligation and takes proper mitigating countermeasures. When the responsible party is taking adequate action, Federal activities are limited to observing, monitoring progress, and providing advice and counsel to the spiller as may be necessary. In the event that the discharger is unknown or the responsible party does not act promptly, does not take or propose to take proper or appropriate actions to contain, cleanup, or dispose of oil spilled, Federal response action shall be instituted in accordance with the Clean Water Act and applicable USCG directives.

j. U.S. Coast Guard--Safety and Pollution Prevention Regulations

Section 4 of the OCSLA grants authority to USCG to promulgate and enforce regulations covering lighting and warning devices, safety equipment, and other safety-related matters pertaining to life and property on fixed OCS platforms and drilling vessels. Through the USCG, DOT advises the Corps of Engineers on the issuance of permits and the placement of offshore structures.

33 CFR 154-157 and 159 prescribe pollution prevention regulations and procedures for the transfer of oil from vessel to vessel (Part 156) and between onshore and offshore facilities and vessels (Part 154), for equipment and procedures to prevent oil pollution from vessels to the marine environment (Parts 155 and 157), and for the design and construction of marine sanitation devices (Part 159) in order that the regulations and standards of USEPA, promulgated under the FWPCA, are met.

33 CFR 140-147 provide the USCG with requirements for safety equipment and other matters relating to safety and for the promotion of life and property on the artificial islands and fixed structures located on the OCS, as established in Section 4(e)(1) of the OCSLA.

46 CFR 107-109 prescribe regulations for the design, construction, inspection, and operation of mobile offshore drilling units. 33 CFR 149 prescribes requirements for pollution equipment that applies to each deepwater port.

The U.S. Department of Transporation's Research and Special Programs Administration announced the policies and practices it has established to carry out the pipeline safety user fee provisions of the Consolidated Omnibus Budget Reconciliation Act of 1985 in the *Federal Register* (51 FR 136) dated July 16, 1986. The Act requires that gas and hazardous liquid pipeline operators pay annual user fees to fund the cost of the Department's pipeline safety program.

k. Executive Order 11990 (May 24, 1977), Protection of Wetlands

This executive order is pertinent to the proposed actions as it states in part:

> "Each agency shall provide leadership and shall take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for: (1) acquiring, managing, and disposing of Federal lands and facilities; (2) providing federally undertaken, financed, or assisted construction and improvements; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities."

l. Executive Order 11988 (May 24, 1977), Floodplain Management

This executive order is pertinent to the proposed actions as it states in part:

> "Each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities for (1) acquiring, managing, and disposing of Federal lands and facilities; (2) providing federally undertaken, financed, or assisted construction and improvements; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities."

m. Regulations for the Prevention of Pollution by Garbage from Ships

The Marine Pollution Research and Control Act of 1987 (Title II of Public Law 100-220) is a recent U.S. law implementing Annex V of the International Convention for the Prevention of Pollution from Ships. Most of the law's regulatory provisions became effective on December 31, 1988. Under provisions of the new law, all ships and watercraft, including all commercial and recreational fishing vessels, are prohibited from dumping plastics at sea. The law also severely restricts the legality of dumping other vessel-generated garbage and solid waste items both at sea and in U.S. navigable waters. The U.S. Coast Guard will enforce the provisions of this law and has developed proposed guidelines for its implementation (53 FR 122, June 24, 1988) calling for adequate trash reception facilities at all ports, docks, marinas, and boat launching facilities.

5. Interrelationship with Other Programs and Proposals

a. National Marine Sanctuaries and National Estuarine Research Reserves

The Estuarine Research Reserves and Marine Sanctuary programs are discussed in Volume 1, Section I.B.6.a. of the Final Regional EIS. Few changes to the program have taken place since the writing of that document. See also Section I.B.6.a. of Final EIS 113/115/116.

Two estuarine research reserves, both in Florida, have been established in the Gulf of Mexico: Rookery Bay Estuarine Research Reserve and Apalachicola Bay and River Estuarine Research Reserve. No marine sanctuaries have been established in the Gulf of Mexico; however, two are located on the Atlantic side of the Florida Keys: Looe Key National Marine Sanctuary and Key Largo Reef Marine Sanctuary.

Both estuarine research reserves and marine sanctuaries are designed and managed to meet the following goals, among others:

(1) enhance resource protection through the implementation of a comprehensive, long-term management plan tailored to the specific resources;

(2) promote and coordinate research to expand scientific knowledge of significant marine resources and improve management decisionmaking;

(3) enhance public awareness, understanding, and wise use of the marine environment through public interpretive and recreational programs; and

(4) provide for optimum compatible public and private use of special marine areas.

Only sites with special marine or historical resources are selected for marine sanctuary status. Sites selected for consideration are evaluated on the merits of resource and human-use values and on the public benefits to be derived from sanctuary status.

Of the four Gulf sites placed on the SEL, only one (the Flower Garden Banks) is located on the Federal OCS, and it is also the only one that has been designated an Active Candidate. The Shoalwater Bay-Chandeleur Sound, Louisiana, site is located in the Central Gulf, encompassing approximately 80 mi^2 (207 km^2) of State waters including seagrass beds and algae. The Baffin Bay, Texas, site in the Western Gulf is a bay-estuary system separated from the Gulf by a barrier island. The fourth site is the Big Bend Seagrass Beds in the Eastern Gulf.

The Flower Garden Banks were named an Active Candidate for designation as a national marine sanctuary (49 FR 30988-30991) on August 2, 1984. Selection of the site as an Active Candidate formally triggers the National Environmental Policy Act process. The NOAA is preparing a draft management plan and a draft environmental impact statement, and it is expected that the final document will be completed in March 1989.

This site, located 110 mi (177 km) offshore, represents the northernmost coral reef community in the Western Gulf of Mexico. The proposed borders of the sanctuary encompass a total of 44 mi^2 (114 km^2). The area is a valuable representation of a tropical coral reef community dominated by hermatypic coral (*Montastrea annularis*, *M. cavernosa*, *Porites asteroides*, and *Diploria strigosa*) and associated reef fishes and invertebrates. The DOI has protected the biological resources of the Flower Garden Banks from possible damage due to oil and gas exploration and development activities by the establishment of a "No Activity Zone" and operational restrictions as described in the Topographic Features Stipulation proposed for Sale 125 (Section II.B.1.c.(1)). The DOI cannot, however, protect these reefs from damage due to activities outside DOI's permitting process. The Gulf of Mexico Fishery Management Council, in its proposed FMP for corals, has designated the area within the 50 fathom (91.4 m) isobath at the Flower Garden Banks as a Habitat Area of Particular Concern (HAPC) (50 CFR 638), but even with such designation the Council may be unable to regulate "nonfishing" activities such as anchoring of ships. The MMS, therefore, supports designation of the reefs as a marine sanctuary in order to protect the reefs from non-oil- and gas-related activities, such as anchoring (which has been shown to be the most destructive of man's activities in the area), the use of heavy trawls (such as roller trawls), and the taking of corals and reef fishes.

b. Deepwater Ports

The Deepwater Port Act of 1974 (33 U.S.C. 1501) gives DOT the authority to license deepwater ports. The purpose of a deepwater port is to provide offshore terminal facilities for the offloading of imported oil from tankers too large for conventional ports (primarily supertankers) and to avoid the need for lightering. The Louisiana Offshore Oil Port (LOOP) is the only deepwater port in the Gulf. It is located in 115 ft of water in Grand Isle Block 59, approximately 19 miles from shore. Vessel access to LOOP is by means of the designated fairway and safety zone (Visual No. 1). No mobile drilling operations or installation of permanent structures may take place in these areas. An anchorage area is also designated in the vicinity of LOOP. Fixed and mobile structures may be placed in anchorages under certain spacing limitations. The North of Gulf and South of Gulf fairways, associated with LOOP, have recently been incorporated into 33 CFR 166, Shipping Safety Fairways. This information was published in the *Federal Register* on July 1, 1985 (50 FR 28989).

The Deepwater Port Liability Fund (33 U.S.C. 1517) was established by the Deepwater Port Act of 1974. The original liability was increased by the 1984 amendments to the Act to become a $4 million liability fund for oil pollution damages. Liability is imposed without regard to fault and includes both cleanup costs and damages. Liability of a vessel owner and operator associated with deepwater port oil spills is limited to $150 per gross tonnage for the vessel or $20 million, whichever is less. Liability of a deepwater port facility is limited to $50 million.

The Act extends only to an oil discharge from a vessel within a deepwater port and the port's navigational safety zone. It applies to LOOP in the Gulf of Mexico. However, if oil is transshipped to another vessel at the port, liability will follow that vessel until the oil is offloaded.

c. Offshore Mining

The Secretary of the Interior is authorized under the OCSLA to issue leases on the OCS for minerals in addition to oil, gas, and sulphur. The Secretary is further supported by Federally legislated policy to foster and encourage private enterprise involvement in mining or mineral activities (Mining and Minerals Policy Act of 1955, P.L. 83-217); to foster and encourage private enterprise in the development, reclamation, recycling, and wise disposal of domestic mineral resources (Mining and Minerals Policy Act of 1970, 30 U.S.C. 21a); and to encourage Federal agencies to facilitate availability and development of domestic resources to meet critical material needs (The National Materials and Minerals Policy Research and Development Act of 1980, 30 U.S.C. 1601-1605). While commercially exploitable mineral commodities are potentially available as surficial or near surficial deposits on the OCS, onshore supplies and an unfavorable economic climate have precluded their development. On August 18, 1988, MMS published in the *Federal Register* the Notices of Proposed Rulemaking concerning the leasing and operations of minerals other than oil, gas, and sulphur on the OCS. Furthermore, NOAA is proposing regulations to govern commercial activities of U.S. citizens regarding exploration and commercial recovery of deep seabed minerals seaward of the Economic Exclusion Zone (EEZ).

A unit sulphur development operations coordination document was filed with MMS and approved on August 6, 1985, for proposed mining operation in Grand Isle Blocks 16, 17, 22, and 23. The MMS also conducted an offshore sulphur/salt lease sale in the Central Gulf of Mexico. The sale was held on February 24, 1988, and 14 leases were issued for sulphur/salt operations.

Prerequisites for future development are the evaluation of the quality and quantity of the resources, followed by technological advances and a supportive economic climate. For a more detailed discussion of offshore mining, see Volume 1, Section I.B.6.d. of the Final Regional EIS.

d. Ocean Dumping

All ocean dumping is regulated by the Marine Protection, Research, and Sanctuaries Act of 1972, as amended (33 U.S.C. 1401 et seq.). Regulations (40 CFR 220 et seq.) implementing the Act require a USEPA permit for all ocean dumping of industrial wastes and municipal sludge materials. The termination of ocean dumping of sewage sludge and industrial wastes by December 31, 1981, was mandated by 33 U.S.C. 1412a. The designated ocean areas where wastes may be disposed are listed in 40 CFR 228. Further, USEPA has published an annual report entitled "Ocean Dumping in the United States." This report includes information on permit holders, type of waste approved for disposal under the permit, and yearly waste volumes disposed. (The USEPA has one designated deepwater disposal area in the Gulf of Mexico, as shown on Visual No. 3.) The site is designated for the incineration of hazardous wastes, should any such permits be issued in the future; there are no incineration permits active at the present time.

The DOD explosives-dumping areas found in the Gulf planning areas are shown on Figure I-5 of Final EIS 94/98/102. Most of the small areas contain a single, undetonated depth charge. For the eight large areas shown, dumping consisted of old ordnance and unexploded (duds) shells and depth charges. No dumping has taken place in any explosive areas since 1969-1970. However, all lessees should take precautions in drilling and locating structures within or near these areas due to the presence of unexploded ordnance. The U.S. Air Force has released an indeterminable amount of unexploded ordnance in Water Test Areas 1-5 as a result of testing and training missions. The exact locations of this unexploded ordnance cannot be determined and all lessees in the Gulf should take precautions in drilling or locating structures in these areas.

e. Dredging Operations

The dredge is used exclusively for excavation in water; it is used to deepen channels, ports, and harbors and to provide fill material for construction of piers, wharves, docks, underwater foundations, dikes, levees, and related water management structures. Dredging occurs to maintain open channels, canals, and waterways and for the excavation of sand, shell, gravel, and other minerals. Permits issued by COE are required for work on structures in navigable waters of the United States, for the discharge of dredged material or fill into navigable waters, and for transportation of dredged material for the purpose of dumping into ocean waters. The COE exercises regulatory authority in navigable waters primarily under the Rivers and Harbors Act of 1899 and the Federal Water Pollution Control Act of 1972. Dredge and fill regulations were revised in July 1975 to include nontidal wetlands. Permits are required by State and local governments, private operators, and other Federal agencies including COE. Permit applications are evaluated to determine the benefits and/or detriments resulting from a proposed action. The COE issues a permit when it determines that the proposal is in the overall public interest.

f. National Defense

The U.S. Navy and Air Force actively use four military warning areas and a portion of a fifth area, plus portions of three water test areas in the CPA and WPA, as shown on Visual No. 3. Military operations within these areas vary in the types of missions performed and their frequency of use. Such missions include carrier maneuvers, missile testing, rocket firing, pilot training, air-to-air gunnery, air-to-surface gunnery, minesweeping operations, submarine operations, air combat maneuvers, aerobatic training, missile testing and development, and instrument training.

In the CPA and WPA, space-use conflicts may develop with increased military testing and training activities and unrestricted oil and gas development crucial to the Nation's economic and military security. The DOI and DOD work together to assure that Federal offshore development does not conflict with military training.

g. Strategic Petroleum Reserve

The 1973 petroleum embargo highlighted the perceived requirement for a petroleum reserve for the United States in the event of interruption of the flow of petroleum in the United States from any cause. This need was met with legislation in the Energy Policy and Conservation Act of 1975 (42 U.S.C. 6201 et seq.), which created the Strategic Petroleum Reserve (SPR), and also provided for the Early Storage Reserve, the Industrial Petroleum Reserve, and the Regional Petroleum Reserve.

The Energy Policy and Conservation Act provided for the amount of the reserve to equal the total volume of oil imported over a consecutive three-month period in 1974-1975 during which average monthly import levels were highest. Based on imports in these months, the SPR Plan recommended a reserve size of 500 million barrels (MMB). The plan stated that if subsequent estimates of national vulnerability showed a need for a larger or smaller Reserve, this requirement would be presented to the Congress as a Plan Amendment.

Based on recent vulnerability assessments, prudence dictated that this country prepare to deal with the possibility of another such interruption. Therefore, SPR Plan Amendment No. 2 increased the size of the SPR to 1,000 MMB. To date, the SPR program has been organized into three major phases consisting of: (1) Phase I, which consists of development of the initial 248 MMB in existing underground capacity available at five salt domes in Texas and Louisiana; (2) Phase II, which consists of the 290 MMB expansion of existing underground storage capacity, increasing SPR's capacity to 538 MMB; and (3) Phase III, which represents expansion of SPR storage capacity by 212 MMB to achieve a 750 MMB reserve by 1989 (US, DOE, 1981).

6. Gulf of Mexico Regional Environmental Studies Program

MMS supports and administers a large, multidisciplinary studies program to develop information needed for assessment and mitigation of impacts to marine and coastal environments that may be affected by OCS oil and gas activities. This program was initiated in 1973 with award of contracts for collection and synthesis of environmental and socioeconomic information and was developed to include major field studies in 1974 and subsequent years. During the period of 1974-1978, the program consisted largely of baseline studies in the South Texas and Eastern

Gulf of Mexico (MAFLA) areas, plus "special studies" of numerous offshore submarine banks of the Texas/Louisiana continental shelf. The baseline studies approach was abandoned in late 1978, and the program was reoriented to include a variety of study approaches. A detailed description of the program's history, objectives, and present composition is presented in Volume 1, Section I.B.7. of the Final Regional EIS, and in the Regional Studies Plan, Fiscal Year 1988 (USDI, MMS, 1988b); study areas for the various field studies are portrayed on Visuals Nos. 6 and 6E.

In these 15 years, $68.7 million has been spent for 129 studies in the Gulf of Mexico. In FY 89, as many as 18 additional awards involving $4.4 million will be considered.

SECTION II

ALTERNATIVES INCLUDING THE PROPOSED ACTIONS

II

II. ALTERNATIVES INCLUDING THE PROPOSED ACTIONS

A. CENTRAL GULF SALE 123

1. Alternative A - The Proposed Action

a. Description of the Proposed Action

The proposed action for Central Gulf Sale 123 is to offer for lease all unleased blocks in the CPA of the Gulf of Mexico (Figure I-1). Central Gulf Sale 123 is scheduled for March 1990 in the 5-Year OCS Oil and Gas Leasing Program (announced April 1988). There were 6,011 unleased blocks containing approximately 32.1 million acres present in the CPA as of December 1988. The actual number of blocks offered for lease will differ from this figure by an amount equal to the number of blocks relinquished, canceled, and terminated during the intervening period. Unleased blocks are located from 3 to 220 miles offshore in water depths ranging from 4 to 3,425 m.

The analyses of impacts summarized below (Section II.A.1.b.) and described in detail in Section IV.D.1.a. are based on a development scenario (Base Case) formulated to provide a set of assumptions and estimates on the amounts, locations, and timing for OCS exploration, development, and production operations and facilities, both offshore and onshore. These are estimates only and not predictions of what will happen as a result of holding this proposed sale. Table II-1 summarizes major elements of the development scenario and related impact producing factors for the proposed action. A detailed discussion of the development scenario and major related impact producing factors is included in Section IV.A. The following major assumptions and estimates are included in the Base Case.

- The discovery and production of 0.17 billion bbls of oil (BBO) and 1.64 trillion cubic feet (tcf) of gas during the period 1992-2023.

- The drilling of 210 exploration and delineation wells during the period 1991-2000.

- The installation of 25 production platforms and the drilling of 290 development wells during the period 1992-2017.

- Oil and gas production beginning in 1992 and reaching peak annual production during the period 2004-2007 for oil (33.4 million bbls) and during the period 2005-2008 for gas (314.7 billion cubic feet).

- Estimated drilling mud solid discharges of 2.28 million bbls; estimated drill cutting discharges of 0.26 million cubic feet per year; formation water discharges of 1.46 billion bbls; and treated sanitary wastes of 105,000 gallons per day.

- All economic gas production and most oil production (at least 53%) transported by pipeline to onshore processing facilities in the central coastal area. Some oil production (up to 47%) transported by shuttle tanker to existing port/terminal facilities and then moved by pipeline (existing network) to processing facilities in the central coastal area.

- The construction of 125 miles of offshore pipeline (gathering and mainline).

- Onshore support and processing are expected to be provided entirely from facilities (primarily in the Central and Western coastal areas) existing prior to the proposed action or from facilities established/constructed subsequent to the proposed action as a result of cumulative oil and gas activity (Federal OCS and other) occurring subsequent to the proposed action. No major facility construction is expected to occur solely as a result of the proposed action.

Table II-1

Summary of Impact Producing Factors Related to the Proposed Sales (Base Case)

	Central Gulf Sale 123	Western Gulf Sale 125
Resources Estimated to be Discovered and Produced		
Oil (billion bbls)	0.17	0.10
Gas (tcf)	1.64	1.48
Offshore Infrastructure to be Developed		
Exploration and Delineation Wells	210	200
Production Platforms	25	20
Development Wells	290	220
Pipeline Miles	125	100
Transportation Assumptions		
Oil - Pipeline (billion bbls/%)	0.09/53	0.04/44
Oil - Shuttle Tanker (billion bbls/%)	0.08/47	0.06/56
Gas - Pipeline (tcf/%)	1.64/100	1.48/100
Offshore Discharges: Total		
Drilling Mud Material (million bbls)	2.28	1.91
Drill Cuttings (million cubic feet/yr)	0.26	0.21
Formation Waters (billion bbls)	1.46	0.87
Treated Sanitary Wastes (1,000 gals/day)	105	84
Sediments Disturbed by Pipeline Installation (million cubic yards)	0.75	0.60
Offshore Air Emissions: Average Annual - 1,000 tons		
Nitrogen Oxides (NO_x)	2.75	1.98
Carbon Monoxide (CO)	0.37	0.26
Sulfur Oxide (SO_x)	0.04	0.02
Volatile Organic Compounds (VOC)	0.83	0.66
Total Suspended Particulates (TSP)	0.00	0.00
Transportation Activity: Peak Year Trips		
Shuttle Tanker Traffic (20,000 dwt/50,000 dwt)	15/6	11/4
Service Vessel Traffic (1,000 trips)	3.671	3.141
Helicopter Traffic (1,000 trips)	6.662	5.658
Estimated Onshore Facilities: Existing Number/New Number		
Service Bases	30/0	13/0
Pipe Coating and Storage Yards	8/0	4/0
Platform Fabrication Yards	20/0	11/0
Pipeline Landfalls	154/0	15/0
Onshore Pipeline (miles)	2,759/0	2,759/0
Gas Processing Plants	93/0	58/0
Oil Refineries	26/0	25/0

Source: Based on MMS unpublished analyses.

b. Summary of Impacts

The following are summaries of the detailed impact analyses that are included in Section IV.D.1.a. It is noted that these summaries are limited to the impact of the proposed action alone (under the Base Case); the cumulative impacts, which are assessed in Section IV.D.1.a., are not summarized here. Table S-2 indicates the level of impact on each resource category estimated as a result of the cumulative factors.

Five levels of impact are defined for each impact topic and used in the conclusion to indicate the degree of intensity or severity of the impact judged from the analysis. The five levels are designated by the following qualitative terms indicating the degree of impact: very high; high; moderate; low; and very low. Definitions of these impact levels for each resource category are provided in Table S-4.

To facilitate the analysis, the Federal offshore area is divided into subplanning areas. The CPA is comprised of four subplanning areas (C-1, C-2, C-3, and C-4) and the coastal region is divided into four coastal subareas (C-1, C-2, C-3, and C-4). These subareas are delineated on Figure IV-1.

(1) Impacts on Sensitive Coastal Habitats

(a) Coastal Barriers

The major impact producing factors which could potentially affect the Gulf's barrier beaches, in association with OCS activities in the Central Gulf, include pipeline emplacement, support infrastructure construction, navigation canal construction and maintenance, oil spills, and OCS trash and debris. The latter topic is discussed in Section IV.D.1.a.(9).

All pipelines constructed to serve leases resulting from the proposed action for Sale 123 are expected to tie into existing trunk lines for transport of the product to shore. Therefore, there should be no pipeline emplacement impacts to coastal barriers as a direct result of the proposed action. If, because of unexpected discoveries, the need arises for more pipelines to come ashore, strategic routing and proper emplacement techniques should serve to minimize impacts.

No new ancillary facilities or new navigation canals are expected to result from the proposed action (Table II-1). However, maintenance dredging of existing navigation canals will occur periodically and this in itself interferes with the dynamics (littoral system) of such a complex, endangering the natural deposition of sand/sediment and the self maintenance of its features.

The impacts of sale-related oil spills on coastal barriers will be short-lived. Even the removal of large quantities of sand in association with cleanup operations, such as occurred after the Alvenus spill, should have only a short-term impact on beach form and dynamics. Furthermore, the chance of a large spill contacting a barrier feature is small.

The lack of any projected new construction of pipelines or facilities and the small probabilities of the occurrence of an oil spill contact and the associated long-term impacts indicate that the impacts of the proposed action on coastal barriers in the CPA are expected to be very low.

(b) Wetlands

No onshore oil/gas-related construction is expected in the CPA as a result of the proposed action (Table II-1). The chance of occurrence of one or more large or small oil spills greater than 50 bbls that will contact wetlands in the CPA is small. Furthermore, the impacts of spilled oil on the growth of wetland vegetation in the Gulf of Mexico has not been shown to be deleterious unless the vegetation and soil is heavily oiled. Although a small spill (> 1 and ≤ 50 bbls) is assumed to contact coastal wetlands, it is not assumed to result in any heavy oiling. Even in heavily oiled wetland areas, oil spill impacts have been short-term, lasting perhaps one or two years. The level of impact on coastal wetlands in the CPA as a result of the proposed action is expected to be low.

(2) Impacts on Sensitive Offshore Habitats and Communities

(a) Live Bottoms (Pinnacle Trend)

As described in Section IV.D.1.a.(2), the major potential impact producing factors that could affect the biota of the live bottom areas in the Central Gulf are oil spills; blowouts; anchor, rig, platform, and pipeline emplacements; discharge of drilling fluid; and platform removal. Routine oil and gas operations resulting from this proposal would cause very high and potentially long-lasting damage due to the relatively small coral and coral community areas of the Gulf if unrestricted operations take place on or near these important sensitive habitats. High deleterious impacts to fish habitats of the live bottoms (pinnacle trend) may also affect the recreational and commercial fisheries of the area, and the intrinsic biological, ecological, and aesthetic values of these areas might be seriously diminished. The live bottom areas of the Central Gulf consist of a "pinnacle trend" in which steeply rising pinnacles and ridges provide shelter for fish of commercial and recreational importance. Routine oil and gas operations resulting from this proposal would cause high impacts to small areas of the pinnacle trend if operations were to directly contact the features. Impacts to the area as a whole, however, are expected to be low. Therefore, the impacts to pinnacle trends are expected to be moderate.

The proposed biological stipulations described in Section II.A.1.d. would, if selected by the Secretary for inclusion in leases, preclude nearly all of the adverse impacts near routine oil and gas lease operations. Adopting the live bottom stipulation would be expected to result in a very low level of impact to live bottoms.

(b) Deepwater Benthic Communities

As described in Section IV.D.1.a.(2), the major impact producing factors that could affect the deepwater benthic communities (e.g., chemosynthetic communities) are anchoring, structure emplacement, and blowouts. Since many of these communities are of low diversity and are believed to be widespread in water depths between 400-1,000 m and since it is assumed that there will be relatively limited oil and gas activity in these depths, oil and gas operations resulting from this proposed action are estimated to cause low impacts to these communities. However, impacts to particularly dense communities (known as "Bush Hill" type communities) could be very high from the bottom-disturbing activities mentioned above. Such a community, depending on its size, could be completely destroyed if the drilling operation set up directly on a community. The Notice to Lessees described in Section II.A.1.d. of Final EIS 118/122 (USDI, MMS, 1988c) reduces the expected impact level from very high to moderate.

(c) Topographic Features

As described in Section IV.D.1.a.(2), the major potential impact producing factors that could affect the biota of the topographic features in the Central Gulf are oil spills; blowouts; anchor, rig, platform, and pipeline emplacements; discharge of drilling fluid; and platform removal. Routine oil and gas operations resulting from this proposal would cause very high and potentially long-lasting damage due to the relatively small coral and coral community areas of the Gulf if unrestricted operations take place on or near these important sensitive habitats. High deleterious impacts to fish habitats of the topographic features may also affect the recreational and commercial fisheries of the area, and the intrinsic biological, ecological, and aesthetic values of these areas might be seriously diminished. Thus, the proposed action is expected to have a very high impact on the sensitive offshore habitats of the topographic features.

The proposed biological stipulations described in Section II.A.1.d. would, if selected by the Secretary for inclusion in leases, preclude nearly all of the adverse impacts near routine oil and gas lease operations. The topographic features stipulation would mitigate impacts to the biota resulting in an expected very low level of impact.

(3) Impacts on Water Quality

(a) Coastal/Nearshore

Coastal/nearshore water quality degradation would occur from routine discharges associated with existing onshore infrastructure such as from process waters discharged from refineries and leakage at marine terminals. The percentage of such discharges that are attributed to this proposed sale, however, would be very small. Probable crude oil spills from both onshore and offshore OCS pipelines, platforms and shuttle tankering, and chronic oil, both crude and diesel, leakage from service vessel and shuttle tankering traffic would contribute slightly to the total hydrocarbon burden of coastal waters. The OCS formation waters discharged in coastal areas would have high localized impacts on the receiving waters. It is estimated that 0.55 billion bbls of formation waters will be discharged into coastal Louisiana waters, primarily into the Mississippi River Delta area. Saltwater intrusion would occur from maintenance dredging of existing navigation channels carrying OCS support vessels. Such dredging would also result in short-term impacts to the affected waterbodies. Support vessel traffic is likely to further impact water quality by accidental release of bilge waters, chronic fuel and tank spills, and by trash due to small amounts of the antifouling paint component, tributyltin, known to be toxic to marine organisms and already contaminating Gulf coastal waters. Although regulated, it is still expected to add to the already existing environmental loading. Although some locations along the coast may experience moderate or high impacts due primarily to produced water discharges and support vessel traffic, regional impacts to coastal and nearshore water quality are expected to be low.

(b) Offshore

As a result of Sale 123, localized offshore water quality degradation will occur in the CPA. Immediate impacts would be brought on by the drilling of up to 210 exploration and delineation wells, 290 development wells, and pipelaying activities resulting in laying up to 125 miles of pipeline (Table II-1). Other impacts would stem from additional dredging activities, and discharges of drilling muds, fluids, cuttings, sanitary and domestic wastes, and formation waters from the 25 new platforms projected for this area. Furthermore, there exists a 21% chance of one or more spills (1,000 bbls or greater) occurring in the planning area (Table IV-5).

The expected impacts are estimated to be high around platforms and construction sites depending on existing local water conditions, with the extent of such impacts extending from only a few meters to tens of meters from these sites. These impacts will decrease to very low with distance (500-1,000 m) from the source. The impact to offshore water quality is expected to be low.

(4) Impacts on Air Quality

Air quality degradation may occur from catastrophic events (blowouts and oil spills) and offshore operational emissions as a result of drilling, platform installation, and production. Additional gas processing or refining capability is not expected to be needed as a result of the proposed action. Potential impacts from criteria pollutants may be felt in areas classified as nonattainment or Prevention of Significant Deterioration (PSD) Class I. The expected levels of OCS-related activities (25 platforms and no new gas processing or refining facilities) will cause little long-term degradation of ambient air quality with no significant effects on nonattainment or PSD areas (Table II-1). Short-term degradation of air quality could occur as a result of uncontrolled release of sour gas from a blowout. Moderate impacts are estimated to occur in St. Bernard, Plaquemines, St. Mary, Lafourche, St. Charles, Jefferson, Orleans, and St. John the Baptist Parishes in Louisiana, and very low impacts are expected throughout the remainder of the coastal area of the Central Gulf.

(5) Impacts on Endangered and Threatened Species

The impact producing factors that could affect endangered and threatened species as a result of the proposed action in the CPA include OCS-related oil spills, collision with offshore support vessels and tankers, oil/gas-related plastic debris, and the use of explosives for seismic exploration and for the removal of offshore structure legs/pilings and well casings (Section IV.A.3.j.; USDI, MMS, 1987a). No threatened or endangered species' terrestrial habitat is proposed for alteration as a result of the proposed action.

(a) Brown Pelicans

Noise and disturbance from offshore operations, including subsurface explosions, should not affect pelicans because of their distance from pelican habitat. Collisions occur infrequently and incidents rarely affect more than one individual. Death or injury by entanglement in or ingestion of debris is chronic but the portion attributable to the OCS is minor.

Oil spillage affects pelicans by physical impairment, contact with toxins, habitat destruction, food contamination, and disturbance from oil response and cleanup efforts. In the Base Case, the probability of one or more large spills (1,000 bbls or greater) occurring and contacting pelican nesting and feeding habitat in the CPA are as follows: Queen Bess Island, 2%; Last Island, 1%; and North and Gaillard Islands, less than 1%. It is also assumed that one spill per year between 1 and 50 bbls (> 1 and ≤ 50 bbls) will occur during the lease life, low percentages of which will be proximate to the coast and a few spills that will contact the coastline. Spills of > 50 bbls < 1,000 bbls will occur more infrequently; it is assumed that one spill will occur during the 34-year life of this sale. None will contact the coastline. Based on the apparent avoidance of oil spills by brown pelicans and the unlikelihood of contact, the impact is estimated to be low. Very low impacts are expected for marine debris and most acoustic disturbances because they occur away from pelican habitat. The impact is estimated to be low.

(b) Sea Turtles

Explosives are used in approximately one-half (58%) of the structure removals in the Gulf. Capillary damage, unconsciousness, and death in turtles can result from these explosions. Explosions are not expected to cause a significant reduction in regional populations because of the few individuals involved and the mitigating strategies imposed by MMS. Entanglement in or ingestion of marine debris can cause drowning, injury, digestive disorders or reduced mobility, resulting in starvation. The OCS activities contribute an unknown quantity of plastiscs to the Gulf. Legal prohibitions and the small amount of debris traceable to oil and gas activities suggest that platforms and vessels are minor contributors. Oil spillage can affect sea turtles by toxic contact, ingestion, inhalation, and excessive expenditure of energy in avoidance. There is a less than 1% probability of a large oil spill occurring and contacting the sea turtle nesting beaches of Louisiana and Mississippi, and a 3% probability of a large spill occurring and contacting the inshore turtle feeding on the south Louisiana coast (Table IV-7). Small spills will occur at the rates discussed above under brown pelicans. Based on the absence of onshore construction, the low probability of sale-related collisions, the mitigating measures deployed during the use of explosives, the avoidance of oil, and the low probability of a lethal contact with oil, populaton declines are expected to last less than one generation. Therefore, the impact is estimated to be low.

(c) Whales

The most likely affects of oil on cetaceans are skin and eye irritations, baleen fouling, asphyxiation from inhalation of volatile fumes, food reduction or contamination, and oil ingestion.

There is a 21% probability of one or more large spills occurring in the Central Gulf during the life of the sale (Table IV-5). Small spills, as discussed in the earlier sections, will also occur. Most of the impacts of oil on whales are short term and sublethal. Subsurface sound from explosions or drilling activity may induce stress and have a cumulative effect on hearing or disrupt acoustic communications. The impacts are estimated to be low because of the whales preference to inhabit areas beyond the continental shelf away from most noise disturbances. Vessel collisions and entanglements are rare. None have been reported in the Gulf, suggesting that OCS shuttle and tanker traffic and OCS debris will not impact whales.

Based on the absence of collision, the entanglements or contact with structures, and the minor effect of short-term oil contact, the impact on whales in the Central Gulf is estimated to be very low.

(6) Impacts on Marine Mammals

The discussion concerning the effects of oil and the probability of a spill for whales (Section II.B.1.b.(5)(c)) is the same for marine mammals.

Entanglement in or ingestion of marine debris, acoustic disturbances, and collision with OCS shuttle and tanker traffic appear to have minor impacts because they occur infrequently and tend to effect a small portion of the population when they occur.

The minor effect of the impact producing factors and the improbability of their occurrence suggest that there will be a low impact on marine mammals.

(7) Impacts on Birds Associated with the Coastal Area

The impact producing factors that could affect coastal and marine birds as a result of the proposed action include offshore oil spills, pipeline landfalls, coastal construction, and oil/gas-related plastic debris. The majority of coastal and marine bird nesting habitats occur inshore, in coastal bays and marshes. The highest estimated probability of one or more large oil spills (1,000 bbls or greater) occurring and contacting a Central Gulf inshore bay is 2% (Barataria Bay). The estimated mean number of large spills occurring and contacting Barataria Bay is less than 0.05. The highest estimated probability of one or more large spills occurring and contacting western deltaic marshes is 6%. The estimated mean number of large spills occurring and contacting western deltaic marshes is 0.1. The majority of the coastal and marine bird feeding habitats occur nearshore or offshore. The highest estimated probability of one or more large spills (1,000 bbls or greater) occurring and contacting a Central Gulf coastline parish is 2% (Plaquemines Parish). The estimated mean number of large spills occurring and contacting Plaquemines Parish is less than 0.05 (Table IV-7). It is assumed that small spills (less than 1,000 bbls) will occur during the 34-year lease life. It is unlikely that a small spill will contact the coastline during the 34-year lease life (Section IV.B.2.b.). This low probability of oil spill contact indicates a low potential for oil contamination of bird species that nest and/or feed in the Central Gulf area. There is a low potential of injury or death of coastal and marine birds from entanglement/ingestion of oil/gas-related plastic debris. As no new coastal construction or pipeline landfalls are estimated to result from the proposed action in the CPA (Table IV-1), there will be no loss of coastal and marine bird habitat. The level of impact on coastal and marine birds is estimated to be very low.

(8) Impacts on the Commercial Fishing Industry

Several impact producing factors from the proposed action could affect the commercial fishing industry, including loss of fishing area through the construction of platforms/structures, underwater OCS obstructions such as pipelines and debris, and oil spills. The majority of Gulf commercial fish species are estuarine dependent. Oil spills contacting coastal bays, estuaries, or marshes could seriously impact Gulf commercial fishery resources. The highest estimated probability of one or more large oil spills (1,000 bbls or greater) occurring and contacting a Central Gulf inshore bay is 2% (Barataria Bay). The estimated mean number of large spills occurring and contacting Barataria Bay is less than 0.05. The highest estimated probability of one or more large spills occurring and contacting western deltaic marshes is 6%. The estimated mean number of large spills occurring and contacting western deltaic marshes is 0.1 (Table IV-7). It is assumed that small spills (less than 1,000 bbls) will occur during the 34-year lease life. However, a few small spills (> 1 and ≤ 50 bbls) are assumed to contact the coastline during the 34-year lease life. No small spills (greater than 50 bbls) will contact the coastline during the 34-year lease life (Section IV.B.2.b.). As a result of these impact producing factors, a very low impact (a 0.1% or less economic loss to the commercial fishing industry, some fishermen affected, but no effect on secondary employment) is estimated to occur on the commercial fishing industry.

(9) Impacts on Recreational Beach Use

Because of a low probability of a large oil spill occurring and contacting recreational beaches (2% or less), no large oil spills are likely to occur and contact major recreational beaches (Table IV-7). Small spill contacts are likely to temporarily discourage recreational use of the portions of beaches most directly impacted until the oil has been removed. In addition, residuals, such as debris and trash associated with offshore operations, will intermittently wash ashore and add to the existing trash and debris problems associated with Gulf of Mexico beaches, causing localized, chronic, adverse aesthetic effects. The level of impact on major shorefront recreational beaches is expected to be low.

(10) Impacts on Archaeological Resources

(a) Historic

The impact producing factors that would affect offshore and onshore historic sites include interactions with drilling rigs, platforms, pipelines, anchors, construction of onshore facilities, and contact by spilled oil. Should an interaction between one of these impact producing factors and an onshore historic site occur, significant or unique historic information could be lost. Since no new onshore development is projected for this proposed action, little damaging interaction will occur; thus, the level of impact is expected to be very low. Since the impacts from an oil spill would generally be temporary and reversible and since the probability for a large oil spill occurring is low, the expected impact to historic resources from oil spills is estimated to be very low.

The MMS will ensure that an archaeological survey is conducted within Archaeological Zones 1 and 2. This survey will reduce the potential for a very high impact from offshore development to low by allowing sites to be located prior to an interaction occurring, thereby making avoidance or mitigation of impacts possible. The impact level for subplanning areas C-2 and C-3 is uncertain because sediment accumulation in these areas during historic times have been sufficient to cover shipwrecks and make them undetectable on side-scan sonar. Because a magnetometer, which is used along with side-scan sonar to detect possible shipwrecks during a survey, does not provide 100% coverage of the seafloor, shipwrecks could go undetected. The impact level in these areas, therefore, could be very high.

(b) Prehistoric

All of the impact producing factors that could affect offshore and onshore historic sites could affect prehistoric sites as well. Should an interaction between one of these impact producing factors and a prehistoric site occur, significant or unique archaeological information could be lost. The potential for such an interaction as a result of onshore development and oil spills is estimated to be low; thus, the level of impact is expected to be very low.

The MMS will ensure that an archaeological survey is conducted within Archaeological Zones 1 and 2. This survey will reduce the potential for a very high impact from offshore development to very low by allowing potential site areas to be located prior to an interaction occurring, thereby making avoidance or mitigation of impacts possible. The expected level of impact is very low.

c. Proposed Mitigating Measures

(1) Topographic Features Stipulation

The topographic features of the Central Gulf provide habitat for coral and coral community organisms (Section III.B.2.). As discussed in Section IV.D.1.a.(2), these communities would be severely adversely impacted (i.e., have an expected impact level of very high) by unrestricted oil and gas activities resulting from the proposed action if such activities took place on or near these communities. The DOI has recognized this problem for some years, and since 1974 stipulations have been made a part of leases on blocks on or near these biotic communities so that impacts from nearby oil and gas activities were mitigated to the greatest extent possible. This stipulation would not prevent the recovery of oil and gas resources, but it would serve to protect valuable and sensitive biological resources. The stipulation is presented as an option for the Secretary's consideration.

The topographic features stipulation was formulated based on consultation with various Federal agencies and comments solicited from State, industry, environmental organizations, and academic representatives. The stipulation wording is based on years of scientific information collected since the inception of the stipulation. This information includes various Bureau of Land Management/MMS-funded studies on the topographic highs in the Central Gulf, numerous stipulation-imposed, industry-funded monitoring reports, and the National Academy of Science (NAS) report entitled Drilling Discharges in the Marine Environment (1983).

The requirements in the stipulation are based on the following facts:

(a) Shunting of the drilling effluent to the nepheloid layer contains the effluent to a level deeper than the level of the living reef of a high relief topographic feature. Shunting is therefore an effective measure for protecting the biota of high relief topographic features (Bright and Rezak, 1978; Rezak and Bright, 1981; NAS, 1983).

(b) Biological effect on the benthos from the deposition of unshunted discharge is mostly limited to within 1,000 m of the discharge (NAS, 1983).

(c) The biota of topographic features can be categorized into depth-related zones defined by degree of reef building activity (Rezak and Bright, 1981 and Rezak et al., 1983 and 1985).

The stipulation would establish No Activity Zones at the topographic features. The zone is defined by the 85 m isobath because, generally, the biota shallower than 85 m are more typical of the Caribbean reef biota, while the biota deeper than 85 m are similar to soft bottom organisms found throughout the Gulf. Where a bank is in water depths less than 85 m, the deepest closing isobath defines the No Activity Zone for that bank. Within the No Activity Zone, no operations, anchoring, or structures would be allowed.

Outside the No Activity Zones, additional restrictive zones would be established within which oil and gas operations could occur but within which drilling discharges would be shunted.

The stipulation would require that all effluents within 1,000 m of the banks with the antipatharian-transitional zone be shunted to within 10 m of the seafloor. Banks containing the more sensitive and productive algal-sponge zone would require a shunt zone extending 1 nmi and an additional 3 nmi shunt zone for development. (The reported algal-sponge zone at Sackett Bank is mostly dead; and Sackett Bank is, therefore, not included with this restriction. Because Sweet Bank in the Central Gulf is small and surrounded by very deep water (the depth drops very quickly to greater than 200 m around the bank), it does not require the protection of the shunt zones; therefore, only a "No Activity Zone" would be established there.

The banks which would cause this stipulation to be applied to blocks of the Central Gulf are:

Bank Name	Isobath (meters)	Bank Name	Isobath (meters)
McGrail Bank	85	Parker Bank	85
Bouma Bank	85	Fishnet Bank[2]	76
Rezak Bank	85	Jakkula Bank	85
Sidner Bank	85	Sweet Bank[1]	85
Sonnier Bank	55	Rankin Bank	85
Sackett Bank[2]	85	29 Fathom Bank	64
Ewing Bank	85	Bright Bank	85
Diaphus Bank[2]	85	Geyer Bank[3]	85
Alderdice Bank	80	MacNeil Bank[3]	82

[1] Only paragraph (a) of the stipulation applies.

[2] Only paragraphs (a) and (b) apply.

[3] Western Gulf of Mexico bank with a portion of its "3 Mile Zone" in the Central Gulf of Mexico.

The stipulation reads as follows:

Topographic Features Stipulation
(Central Planning Area)

(a) No activity including structures, drilling rigs, pipelines, or anchoring will be allowed within the listed isobath ("No Activity Zone") of the banks as listed above.

(b) Operations within the area shown as "1,000 Meter Zone" shall be restricted by shunting all drill cuttings and drilling fluids to the bottom through a downpipe that terminates an appropriate distance, but no more than ten meters, from the bottom.

(c) Operations within the area shown as "1 Mile Zone" shall be restricted by shunting all drill cuttings and drilling fluids to the bottom through a downpipe that terminates an appropriate distance, but no more than ten meters, from the bottom. (Where there is a "1 Mile Zone" designated, the "1,000 Meter Zone" in paragraph (b) is not designated.)

(d) Operations within the area shown as "3 Mile Zone" shall be restricted by shunting all drill cuttings and drilling fluids from development operations to the bottom through a downpipe that terminates an appropriate distance, but no more than ten meters, from the bottom.

Effect of the Lease Stipulation

The purpose of the stipulation is to protect the biota of the topographic features from adverse effects due to routine oil and gas activities; if adopted, the stipulation would reduce the expected impact level from very high to very low. Such effects include physical damage from anchoring and rig emplacement and potential toxic and smothering effects from muds and cuttings discharge. The topographic features stipulation has been used on leases for the past 14 years. Experience since 1974 shows conclusively that the stipulation works to prevent damage to the biota of these banks from routine oil and gas activities. Anchoring by the oil and gas industry has been prevented from occurring on the sensitive portions of the features. Monitoring studies conducted as required by the stipulation have demonstrated that the shunting requirements are effective in preventing the muds and cuttings from impacting the biota of the banks. The proposed stipulation, if implemented, would continue to protect the biota of the banks, specifically as discussed below.

Mechanical damage is probably the single most severe impact to benthic areas resulting from oil and gas operations. The "No Activity Zones" would completely eliminate this threat to the area within the zones from leasing activities. The sensitive biota would thus be protected.

The stipulation would require that all effluents within 1,000 m of Sackett, Fishnet, and Diaphus Banks, categorized by Rezak and Bright (1981) as Category C banks, be shunted into the nepheloid layer.

The categories of Rezak and Bright (1981) and their definitions are:

Category A: zone of major reef-building activity; maximum environmental protection recommended;
Category B: zone of minor reef-building activity; environmental protection recommended;
Category C: zone of negligible reef-building activity, but crustose algae present; environmental protection recommended; and
Category D: zone of no reef-building or crustose algae; protection not recommended.

The biota of the antipatharian zone located at these banks would thus be protected from impact from drilling discharges within the 1,000 m zone because the potentially harmful materials (in drilling muds) would be trapped in the bottom boundary layer and would not get up on the bank where the biota of concern are located. Surface drilling discharge at distances greater than 1,000 m from the bank is not expected to impact the biota since effects from drilling discharge are limited to 1,000 m.

The stipulation would protect the remaining Category A and B banks with greater restrictions. Surface discharge would not be allowed within 1 nmi of these more sensitive banks. Thus, the stipulation would prevent impacts to the biota of these sensitive banks from drilling discharges within 1 nmi. Surface discharges outside of 1 nmi are not expected to impact the biota of the banks as effects from surface discharge are limited to 1,000 m. However, it is possible that because multiple wells from a single platform (surface location) are typically drilled during development operations, extremely small amounts of muds discharged more than 1 nmi from the bank may reach the bank. In order to eliminate the possible cumulative effect of muds discharged during development drilling outside of 1 nmi, the stipulation would impose a "3 Mile Zone" in which shunting of development well effluent would be required.

The stipulation would prevent damage to the biota of the banks from routine oil and gas activities resulting from the proposed action. Furthermore, oil and gas resources present near such areas could be recovered. However, the stipulation would not protect the banks from the adverse effects of an accident such as a large blowout on a nearby oil or gas operation. Historically, blowouts are rare in the Gulf.

(2) Live Bottom (Pinnacle Trend) Stipulation

A small portion of the northeastern CPA (Figure II-1) is characterized by a pinnacle trend which is classified as a live bottom under the definition in the stipulation. The pinnacles in the trend could experience high impacts from physical damage of unrestricted oil and gas activities. The live bottom stipulation is intended to protect the pinnacle trend from damage and, at the same time, provide for recovery of oil and gas resources.

The stipulation reads as follows:

> Live Bottom (Pinnacle Trend) Stipulation
> (Central Planning Area)
>
> (To be included only on leases in the following blocks: Main Pass Area, South and East Addition Blocks 219-226, 244-266, 276-288; Viosca Knoll Blocks 521, 522, 564, 565, 566, 609, 610, 654, 692-698.)
>
> For the purpose of this stipulation, "live bottom areas" are defined as seagrass communities; or those areas which contain biological assemblages consisting of such sessile invertebrates as sea fans, sea whips, hydroids, anemones, ascidians, sponges, bryozoans, or corals living upon and attached to naturally occurring hard or rocky formations with rough, broken, or smooth topography; or areas whose lithotope favors the accumulation of turtles, fishes, and other fauna.
>
> Prior to any drilling activities or the construction or placement of any structure for exploration or development on this lease, including, but not limited to, well drilling and pipeline and platform placement, the lessee will submit to the Regional Director (RD) a live bottom survey report containing a bathymetry map prepared utilizing remote sensing techniques. The bathymetry map shall be prepared for the purpose of determining the presence or absence of live bottoms which could be impacted by the proposed activity. This map shall encompass such an area of the seafloor where surface disturbing activities, including anchoring, may occur.
>
> If it is determined that the live bottoms might be adversely impacted by the proposed activity, the RD will require the lessee to undertake any measure deemed economically, environmentally, and technically feasible to protect the pinnacle area. These measures may include, but are not limited to, the following:
>
> (a) the relocation of operations; and
>
> (b) the monitoring to assess the impact of the activity on the live bottoms.

Effect of the Lease Stipulation

The pinnacle trend is known to exist in a general area in the CPA (Ludwick and Walton, 1957; Vittor and Associates, 1985); however, the trend is patchy. The stipulation would operate to identify the individual pinnacles or topographic features that may be present in the block. The stipulation would require that a survey be done to encompass the potential area of proposed surface disturbance and that a bathymetry map be made from this survey. The bathymetry map would depict any pinnacles or topographic features in the vicinity of the proposed activity. (It should be noted that this "Pinnacle Trend Stipulation" differs from the long-established Live Bottom Stipulation of the Eastern Gulf by not requiring photodocumentation in the pinnacle trend area.) The pinnacles provide habitat for various mobile species, and in some widely scattered areas, plush epibiotic communities have been documented. The assemblages are visually very similar to the Eastern Gulf of Mexico low-relief, live-bottom communities but are dependent upon the carbonate outcroppings of the pinnacle region for attachment sites. Because of this hard-bottom dependence, the remote-sensing techniques used to document the presence of the topographic features will

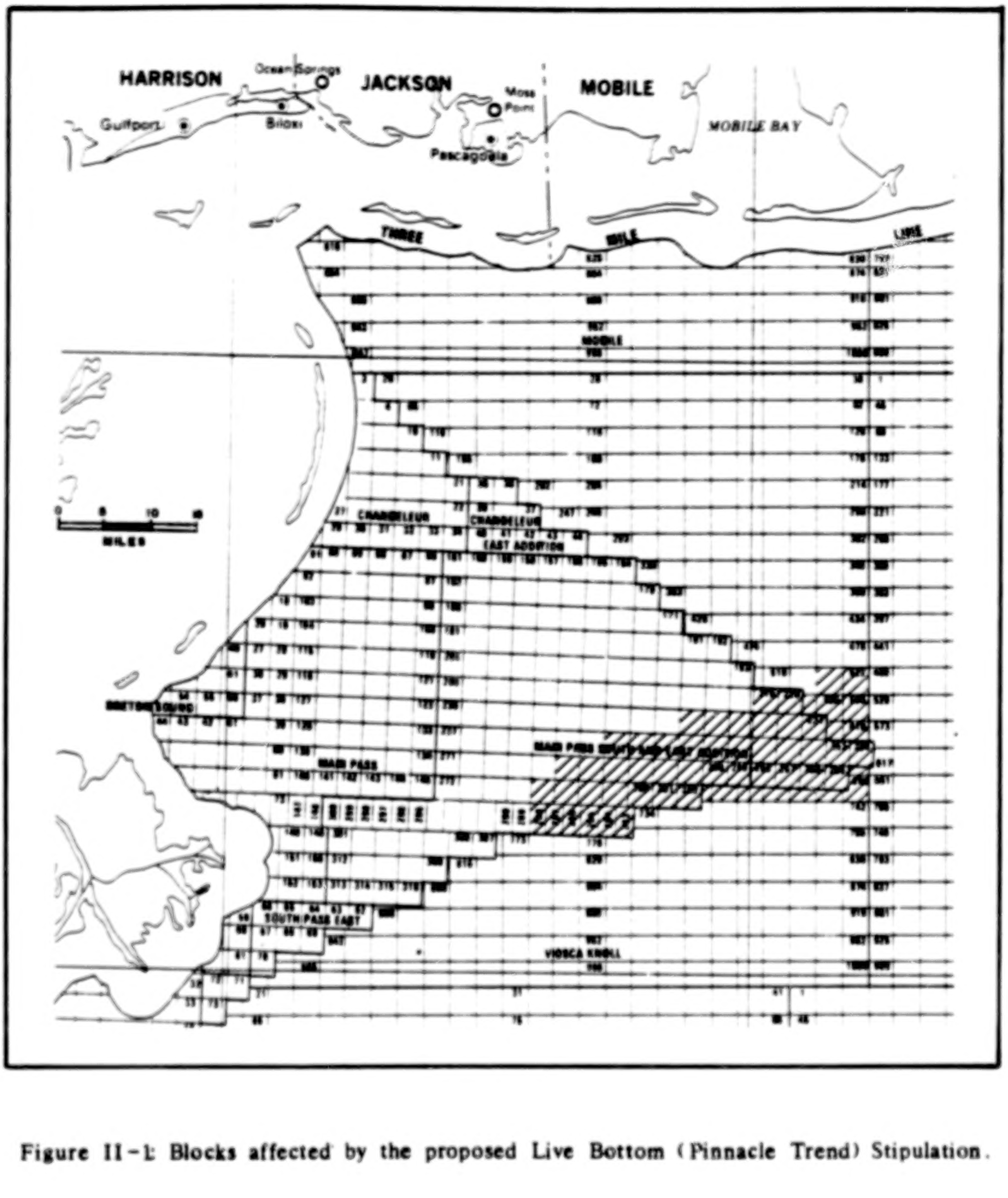


Figure II-1: Blocks affected by the proposed Live Bottom (Pinnacle Trend) Stipulation.

also serve to encompass the areas of hard-bottom communities. The Regional Director (RD), through consultation with the FWS, could then decide if pinnacles in the trend would be potentially impacted and, if so, require any appropriate mitigative measures. Furthermore, NMFS may review selected Plans of Operation and Development and provide comments to MMS.

By identifying the individual pinnacles present at the activity site, the lessee could be directed to avoid placement of the drilling rig and anchors on the sensitive areas. Thus, mechanical damage to the pinnacles and associated communities would be eliminated by the imposition of the stipulation. The stipulation does not address the discharge of effluents near the pinnacles because the pinnacle trend is subjected to heavy natural sedimentation and, therefore, is unlikely to be affected by drilling discharge.

The live bottom stipulation has been used on leases over the past 14 years. Experience from the use of the live bottom stipulation in the Central and Eastern Gulf shows that the stipulation works to identify and protect the live bottom biota. Thus, the stipulation, if adopted, would serve to reduce the expected local impact level from high to very low.

(3) Archaeological Resource Stipulation

(a) "Archaeological resource" means any prehistoric or historic district, site, building, structure, or object (including shipwrecks); such term includes artifacts, records, and remains which are related to such a district, site, building, structure, or object (16 U.S.C. 470w(5)). "Operations" means any drilling, mining, or construction or placement of any structure for exploration, development, or production of the lease.

(b) If the Regional Director (RD) believes an archaeological resource may exist in the lease area, the RD will notify the lessee in writing. The lessee shall then comply with subparagraphs (1) through (3).

(1) Prior to commencing any operations, the lessee shall prepare a report, as specified by the RD, to determine the potential existence of any archaeological resource that may be affected by operations. The report, prepared by an archaeologist and geophysicist, shall be based on an assessment of data from remote-sensing surveys and of other pertinent archaeological and environmental information. The lessee shall submit this report to the RD for review.

(2) If the evidence suggests that an archaeological resource may be present, the lessee shall either:

(i) Locate the site of any operation so as not to adversely affect the area where the archaeological resource may be; or

(ii) Establish to the satisfaction of the RD that an archaeological resource does not exist or will not be adversely affected by operations. This shall be done by further archaeological investigation, conducted by an archaeologist and a geophysicist, using survey equipment and techniques deemed necessary by the RD. A report on the investigation shall be submitted to the RD for review.

(3) If the RD determines that an archaeological resource is likely to be present in the lease area and may be adversely affected by operations, he will notify the lessee immediately. The lessee shall take no action that may adversely affect the archaeological resource until the RD has told the lessee how to protect it.

(c) If the lessee discovers any archaeological resource while conducting operations on the lease area, the lessee shall report the discovery immediately to the RD. The lessee shall make every reasonable effort to preserve the archaeological resource until the RD has told the lessee how to protect it.

There are two archaeological management zones in the Gulf of Mexico (Visual No. 1). Zone 1 has a high potential both for the occurrence of historic shipwrecks and for prehistoric sites. Zone 2 has a high potential only for prehistoric sites. All blocks leased in Sales 118 and 122, which fall within Archaeological Zones 1 or 2, will require a remote sensing survey as specified in NTL 75-3 (Revision No. 1) and LTL's dated July 17, 1984; March 5, 1986; and March 9, 1987. Additionally, all blocks containing known shipwrecks (Tables III-18 and III-19 of Final EIS 110/112 [Erratum: Table III-18--Sheherozada - Survey data show this tanker to lie in Eugene Island Block 191.]) which fall outside Zones 1 and 2 would require surveys at 150 m linespacing, if leased.

The lease stipulation is only a mechanism whereby MMS can require the lessee to conduct an archaeological survey prior to development. It is the survey, not the stipulation itself, that reduces the impact to archaeological resources as described in Section IV. In the absence of a lease stipulation, MMS would still be required to ensure that an archaeological survey was conducted prior to lease development in areas having a high probability for site occurrence. Therefore, the lease stipulation in and of itself does not reduce the potential impact to archaeological resources, but it is, nonetheless, a very effective mechanism to mitigate potential impacts to archaeological resources.

(4) Military Areas Stipulation

The military areas stipulation has been applied to blocks in military warning and water test areas in past lease sales in the Central Gulf. The areas are shown on Visual No. 3. The military has had no problems to date with joint usage and has always recommended utilizing the stipulation on all leasing operations within their warning areas.

The stipulation reads as follows:

Military Areas Stipulation No. 1

Hold and Save Harmless

Whether compensation for such damage or injury might be due under a theory of strict or absolute liability or otherwise, the lessee assumes all risks of damage or injury to persons or property, which occur in, on, or above the Outer Continental Shelf (OCS), to any persons or to any property of any person or persons who are agents, employees, or invitees of the lessee, its agents, independent contractors, or subcontractors doing business with the lessee in connection with any activities being performed by the lessee in, on, or above the OCS, if such injury or damage to such person or property occurs by reason of the activities of any Agency of the United States Government, its contractors or subcontractors, or any of its officers, agents or employees, being conducted as a part of, or in connection with, the programs and activities of the command headquarters listed in Table II-2.

Notwithstanding any limitation of the lessee's liability in Section 14 of the lease, the lessee assumes this risk whether such injury or damage is caused in whole or in part by any act or omission, regardless of negligence or fault, of the United States, its contractors or subcontractors, or any of its officers, agents, or employees. The lessee further agrees to indemnify and save harmless the United States against all claims for loss, damage, or injury sustained by the lessee, or to indemnify and save harmless the United States against all claims for loss, damage, or injury sustained by the agents, employees, or invitees of the lessee, its agents, or any independent contractors or subcontractors doing business with the lessee in connection with the programs and activities of the aforementioned military installation, whether the same be caused in whole or in part by the negligence or fault of the United States, its contractors, or subcontractors, or any of its officers, agents, or employees and whether such claims might be sustained under a theory of strict or absolute liability or otherwise.

Table II-2

Warning Areas' Command Headquarters

Central Planning Area

Warning Areas	Command Headquarters
W-155 (for agreement)	Chief, Naval Air Training Naval Air Station Corpus Christi, Texas 78419-5100
W-155 (for operational control)	Fleet Area Control & Surveillance Facility (FACSFAC) Naval Air Station Pensacola, Florida 32508
W-92	Naval Air Station Air Operations Dept. Air Traffic Division/Code 52 New Orleans, Louisiana 70146-5000
W-453	159th Tactical Fighter Group (ANG) NAS NOLA New Orleans, Louisiana 70143
EWTA-1 EWTA-3	Commander Armament Division Eglin AFB, Florida 32542

Western Planning Area

Warning Areas	Command Headquarters
W-228	Chief, Naval Air Training Naval Air Station Corpus Christi, Texas 78419-5100
W-602	Director, Air Space Management Deputy Chief of Staff, Operations Headquarters Strategic Air Command Offutt AFB, Nebraska 68113-5001

Source: USDI, Minerals Management Service, Gulf of Mexico OCS Region.

Electromagnetic Emissions

The lessee agrees to control its own electromagnetic emissions and those of its agents, employees, invitees, independent contractors or subcontractors emanating from individual designated defense warning areas in accordance with requirements specified by the commander of the command headquarters listed in Table II-2 to the degree necessary to prevent damage to, or unacceptable interference with Department of Defense flight, testing, or operational activities, conducted within individual designated warning areas. Necessary monitoring control, and coordination with the lessee, its agents, employees, invitees, independent contractors or subcontractors, will be affected by the commander of the appropriate onshore military installation conducting operations in the particular warning area; provided, however, that control of such electromagnetic emissions shall in no instance prohibit all manner of electromagnetic communication during any period of time between a lessee, its agents, employees, invitees, independent contractors or subcontractors and onshore facilities.

Operational

The lessee, when operating or causing to be operated on its behalf, boat, ship, or aircraft traffic into the individual designated warning areas, shall enter into an agreement with the commander of the individual command headquarters listed in Table II-2, upon utilizing an individual designated warning area prior to commencing such traffic. Such an agreement will provide for positive control of boats, ships, and aircraft operating into the warning areas at all times.

Effect of the Lease Stipulation

The hold harmless section of the military stipulation serves to protect the U.S. Government from liability in the event of an accident involving the lessee and military activities. The actual operations of the military and the lessee and its agents will not be affected.

The electromagnetic emissions section of the stipulation requires the lessee and its agents to reduce and curtail within some areas the use of radio, CB, or other equipment emitting electromagnetic energy. This serves to reduce the impact of oil and gas activity on the communications of military missions and reduces the possible effects of electromagnetic energy transmissions on missile testing, tracking, and detonation.

The operational section requires notification to the military of oil and gas activity to take place within a military use area. This allows the base commander to plan military missions and maneuvers to avoid the areas where oil and gas activities are taking place, or to schedule around the activities. Prior notification helps to reduce the potential impacts associated with vessels and helicopters traveling unannounced through areas where military activities are underway.

The military stipulation reduces potential impacts, particularly in regards to safety, but does not reduce or eliminate the actual physical presence of oil and gas operations in areas where military operations are conducted. The reduction in potential impacts resulting from this stipulation makes multiple-use conflicts most unlikely. Without the stipulation, some potential conflict is likely. The best indicator of the overall effectiveness of the stipulation may be that there has never been an accident involving a conflict between military operations and oil and gas activities.

2. Alternative B - Delete Biologically Sensitive Offshore Habitats

This deletion option is offered for the Secretary's consideration and would protect valuable offshore biological resources. It affects the biologically sensitive banks (topographic features) of the Central Gulf.

All of the blocks included in the deletion alternative are also the blocks which would be covered by the Topographic Features Stipulation (discussed in Section II.A.1.d.(1)) which may be adopted by the Secretary to protect the biological habitats of these areas. Furthermore, the Secretary may choose to adopt only a part of this alternative, either alone or in conjunction with the proposed biological stipulation, in order to promote the environmental protection policies of the Department.

a. Description of the Alternative

This option would delete the 65 unleased blocks of the total 167 blocks that are on or near biologically sensitive areas of topographic features in the Central Gulf; this would not delete blocks affected by the Live Bottom (Pinnacle Trend) Stipulation. This deletion alternative is presented as an environmental protection measure. The blocks that could be deleted under this alternative are the same as those referred to in Section II.A.1.d.(1) above and are listed in Appendix A.

b. Summary of Impacts

Selection of this option would serve to protect the sensitive high value coral and coral-related communities of the Central Gulf topographic features from the potential harm resulting from oil and gas activities emanating from leases issued as a result of this proposed action. Only 65 blocks (of the 6,011 blocks to be offered) would be deleted from the proposed sale under this alternative, and the resource estimates for the proposed action would not be significantly reduced as a result of adopting this alternative. (Oil spill assumptions would also remain the same.) All impacts of this proposed action, other than those to the topographic features, would thus be unchanged. Section IV.D.1.b. provides a full discussion of the impacts of this alternative. Deletion of all these blocks would provide full protection to the biota of these areas from direct operations which would have resulted from leasing these blocks; however, some impacts may still occur from operations adjacent to this area. The Topographic Features Stipulation of Section II.A.1.d.(1), if adopted, would provide further control and reduce the potential impacts to very low as compared to Alternative A, but it would not remove all risk.

3. Alternative C - No Action

a. Description of the Alternative

The alternative is equivalent to cancellation of a sale scheduled for a specific timeframe on the approved 5-year OCS Oil and Gas Leasing Schedule. Sales in the Central Gulf are scheduled on an annual basis. By canceling the proposed sale, the opportunity is postponed or foregone for development of the estimated 0.17 BBO and 1.64 tcf of gas that could have resulted from this sale in the Central Gulf.

b. Summary of Impacts

All impacts, positive and negative, associated with the proposed action (as discussed in Section IV.D.1.a.) would be canceled and the importation of foreign oil at present or increased levels would be continued. Impacts from Alternative C would result in no effect on resources. There could be a slight increase of environmental risk of oil spills caused by tankering imported oil. Adverse socioeconomic impacts could include loss of employment opportunities, payroll revenues, and tax revenues. The economic stability of the coastal region could be negatively affected. Development of alternative energy supplies as replacement resources for lost domestic OCS oil and gas production include energy conservation; conventional oil and gas supplies; coal; nuclear power; oil shale; tar sands; hydroelectric power; solar and geothermal energy; and imports of oil, natural gas, and LNG. See Section IV.D.1.c. for a discussion of the development of alternative energy supplies as replacement sources for lost domestic production. Table IV-21 presents replacement energy equivalents for the estimated resources for this sale.

4. Comparison of Alternatives

Table S-2 provides a comparison and summary of the impact levels of the proposed action (Alternative A), deletion of biologically sensitive offshore habitats (Alternative B), no action (Alternative C), and the cumulative analyses for Sale 123. The definitions of the levels of impact used are in Table S-4.

Alternative A, the proposed action (Base Case), has the potential to result in low to very low impacts to a majority of the resources analyzed, with the exceptions being air quality and sensitive offshore habitats. The level of impact on air quality is estimated to be moderate; whereas, the levels of impact on sensitive offshore habitats range from low to very high (Table S-2). The level of impact for archaeological resources is anticipated to be very low in coastal areas. The biological and archaeological stipulations are being considered for adoption as mitigating measures. If the proposed stipulations are adopted, the level of impact to biological resources would be reduced to very low; however, the level of impact for archaeological resources would remain the same as without the stipulation. One exception is historic shipwrecks in the eastern portion of the Central Gulf where the level of impact is still anticipated to be very high.

Alternative B, deletion of biologically sensitive offshore habitats, would preclude any impacts to topographic features and would have the same levels of impact as Alternative A for the remainder of the resource categories listed in Table S-2.

Alternative C, no action, equates to cancellation of the sale and would preclude any impacts to the resource categories listed in Table S-2 from the proposed action or other alternatives.

B. WESTERN GULF SALE 125

1. Alternative A - The Proposed Action

a. Description of the Proposed Action

The proposed action for Western Gulf Sale 125 is to offer for lease all unleased blocks in the WPA of the Gulf of Mexico (Figure I-1), with the exception of two unique and highly sensitive blocks in the Flower Garden Banks (Blocks A-398 and A-375 in the High Island, East Addition, South Extension area). These blocks have also been excluded from the last five Western Gulf sales and are a subarea deferral listed in the 5-Year OCS Oil and Gas Leasing Program.

Western Gulf Sale 125 is scheduled for August 1990 in the 5-Year OCS Oil and Gas Leasing Program (announced April 1988). There were 5,055 unleased blocks containing approximately 27.8 million acres present in the WPA as of January 1989. The actual number of blocks offered for lease will differ from this figure by an amount equal to the number of blocks relinquished, canceled, and terminated less the number of blocks leased during the intervening period. Unleased blocks are located from 9 to 222 miles offshore in water depths ranging from 8 to over 3,000 m.

The analyses of impacts summarized below (Section II.B.1.b.) and described in detail in Section IV.D.2.a. are based on a development scenario (Base Case) formulated to provide a set of assumptions and estimates on the amounts, locations, and timing for OCS exploration, development, and production operations and facilities, both offshore and onshore. These are estimates only and not predictions of what will happen as a result of holding this proposed sale. Table II-1 summarizes major elements of the development scenario and related impact producing factors for the proposed action. A detailed discussion of the development scenario and major related impact producing factors is included in Section IV.A. The following major assumptions and estimates are included in the Base Case.

- The discovery and production of 0.10 BBO and 1.48 tcf of gas during the period 1992-2023.
- The drilling of 200 exploration and delineation wells during the period 1991-2000.
- The installation of 20 production platforms and the drilling of 220 development wells during the period 1992-2018.

SECTION III

DESCRIPTION OF THE AFFECTED ENVIRONMENT

III

III. DESCRIPTION OF THE AFFECTED ENVIRONMENT

A. PHYSICAL ELEMENTS OF THE ENVIRONMENT

1. Environmental Geology and Hazards

a. Geology

Geology of the Central and Western Gulf of Mexico is shown on Visual No. 5, and the general sediment distribution is shown on Visual No. 4. The description of geology of the Central and Western Gulf of Mexico is hereby incorporated by reference from Volume 1 of the Final Regional EIS (USDI, MMS, 1983a, pages 119-123). Presented below is a summary of that material. The continental margin of the northern Gulf of Mexico is composed of a broad wedge of Mesozoic and Cenozoic strata that accumulated almost continuously from Jurassic time to the present. Mesozoic and Cenozoic deposits are more than 15 km thick beneath the lower coastal plain and adjacent continental shelf. For the most part, the margin is a Cenozoic clastic platform built by the deposition of sediments from the continental interior. Sediment supplies generally exceeded the subsidence rate, prograding the seaward face of the margin more than 400 km from the edge of Cretaceous carbonate platform deposits under the coastal plain to the present position of the continental slope.

Major structural anomalies found in the region include salt diapirs, growth faults, and shale uplifts. Salt structures are concentrated inland along the coast from central Texas to DeSoto Canyon and across the continental shelf to the foot of the slope. Regional systems of growth faults penetrate into the Cenozoic units beneath coastal Texas and Louisiana and the adjacent shelf. Many of these faults formed as a response to sediment overloads along Tertiary and Quaternary shelf edges, to differential compaction associated with abrupt changes in sediment thickness and gross lithology, and (locally) to the withdrawal of large volumes of salt from depths during diapiric growth.

The prospective horizons of the northwestern continental shelf are of Miocene, Pliocene, or Pleistocene age. The environment of deposition of the continental shelf and slope in the northern Gulf of Mexico is one of the most significant factors controlling hydrocarbon production. Sediments deposited on the outer shelf and upper slope have the greatest potential for bearing hydrocarbons. This environment is the optimum zone for encountering the three ingredients necessary for the successful formation and accumulation of oil and gas: reservoir rock, source beds, and traps.

A number of discoveries have recently been made along the outer shelf and upper slope offshore of Louisiana and Texas in sediments of Pleistocene age known as the Flexure Trend. On the upper slope, basinal areas between salt structures contain a thickness of as much as 3,500 m of sediment, most of which appear to be muddy, slump deposits with infrequent turbidite sand zones. Some of the new discoveries indicate that turbidite sands of reservoir quality are present on the upper slope, especially in deposits of Pleistocene age. These turbidite sands would have been derived from inner shelf areas and deposited during glacial epochs when sea level was lower and the shoreline was close to the present shelf edge.

A recently completed MMS-funded study (Berryhill, 1987) has investigated the spatial and vertical dimensions of Late Quaternary facies that occur on the continental shelf and upper slope of the northern Gulf of Mexico. This effort was the first comprehensive study of a continental shelf that relied on high-resolution seismic data as the primary data source. Study results were based on analyses of 90,000 miles of subbottom profiler and 45,000 miles of minisparker data. The study presents late Quaternary seismic reflection models that can be used as exploration tools and demonstrates the interactions and processes that are involved among sediment deposition, diapirism, and sea level fluctuations in the building of the continental shelf.

b. Geologic Hazards

The description of geologic hazards is hereby incorporated by reference from Volume 1 of the Final Regional EIS (pages 123-129). Presented below is a summary of that material. Within the Central and Western Gulf of Mexico, geohazards to oil and gas development are associated with seafloor geologic features that result in seafloor instability. Primarily, the hazards are produced by (1) increased gradient at the edge of the continental shelf where it merges with the continental slope; (2) regional high rates of deposition on the continental shelf that cause isostatic adjustments and deep-seated gravity faulting; (3) local high rates of deposition of unconsolidated sediments on the increased gradient of the continental shelf edge that have led to intensive slumping and mudslides; (4) diapiric movement of low-density material through overlying sediment that has caused extensive deformation, the damming of sediments, gravity faulting, and slumping; and (5) high biogenic gas content in rapidly deposited sediments.

Most structures and equipment used for minerals exploration and development can be designed to withstand the stresses of the continental shelf environment if adequate information is available. Studies developed under the former BLM Environmental Studies Program have been especially directed toward areas where more detailed geologic information was needed for intelligent management of the OCS mineral leasing program. Visual No. 6 shows the area where MMS/BLM geologic studies have provided detailed information and mapping.

These studies have assessed operational constraints to oil and gas exploration and production. The data and mapped information are being used daily for tract evaluation, stipulation development and application, pipeline permit processing, protection of sensitive areas such as the Flower Garden Banks, preliminary platform emplacement, and pipeline routing.

c. Non-Oil and Non-Gas Mineral Resources

Several minerals in the Central Gulf of Mexico are now, or have the potential to become, commercially exploitable. For example, the State of Louisiana is assessing and mapping sand deposits for use in shoreline restoration. Although most of these deposits occur in State waters, some potential deposits have been found in Federal waters. Deposits of quartz sand in Federal and State waters off the coasts of Mississippi and Alabama are of interest because of their potential use in the production of glass. Sulphur and salt deposits associated with the large number of diapiric and domed structures in the OCS seafloor have mining potential. The Caminada sulphur mine in Federal waters has recently been activated and is presently in production, and DOI conducted an offshore sulphur and salt lease sale in the Central Gulf of Mexico on February 24, 1988.

Onshore, nonenergy minerals that occur in the coastal zone of the Central Gulf of Mexico include sand, gravel, and quartz sand in Mississippi and Alabama; sulphur, salt, and shell in Louisiana; and reclaimed sulphur in Alabama (USDI, Bureau of Mines, 1985).

As part of the national initiative to develop the marine mineral resources of the OCS, MMS is working with the Gulf coastal states to complete preliminary economic reconnaissance studies of nonenergy marine minerals. These efforts were begun during the summer of 1987. During the Ninth Annual Gulf of Mexico Information Transfer Meetings, sponsored by MMS in October 1988, a session entitled "Marine Mineral Resources in the Northern Gulf of Mexico" presented progress reports on these efforts by the participating states.

d. Natural Oil and Gas Seepage

The description of natural oil and gas seepage is hereby incorporated by reference from Final EIS 113/115/116 (pages III-5 through III-6). Presented below is a summary of that material. Historical and contemporary data indicate that hydrocarbon seepage has been occurring in the Gulf of Mexico and elsewhere in the petroleum provinces of the world. NAS (1975) estimated that natural seeps are responsible for 10% of the petroleum entering the marine environment and that 90% is in the form of pollutants associated with petroleum production, transportation, and use. Marine transportation is responsible for an estimated 35%, and runoff from rivers and urban areas is responsible for 31% of the petroleum entering the sea. Ten years later, the National Research Council (1985) estimated that about 8% of the hydrocarbons in the sea are derived from natural seeps and the erosion of hydrocarbon-bearing sediments, 46% from transportation, and 37% from runoff.

Natural seeps of oil and gas are difficult to pinpoint in the deeper water areas of the Gulf of Mexico, but many areas having anomalous concentrations of hydrocarbons in the water column have been recorded with chemical "sniffers," and in some cases seeps into the water column show up on subbottom profiler records. Many of these seeps occur at a considerable distance from commercial production and some have been discovered around the same diapiric structures on the continental shelf in the Gulf of Mexico that provide substrate for biological banks.

Deepwater research in the Gulf of Mexico in recent years has focused on several areas where natural seeps occur on the continental slope. As a result of an MMS study entitled *Northern Gulf of Mexico Continental Slope Program*, seeps of both oil and gas have been observed and photographed from deep submersibles and remote vehicles and have been found to support chemosynthetic communities of large tube worms, mussels, and clams. These organisms derive their nutrition from dissolved gases, such as methane and hydrogen sulfide, and do not require the usual organic food sources from photosynthesis. Research funded by the Offshore Operators Committee (Brooks et al., 1986) has demonstrated that these communities occur widely on the northern Gulf continental slope at sites of oil and gas seeps. See also Section III.B.2. for further information on deepwater chemosynthetic communities.

2. Meteorological Conditions

The Gulf of Mexico and adjacent coastal areas are part of the Atlantic tropical cyclone basin. Because of its extensive coastal region and almost complete enclosure by land, the Gulf is also a favorable region for the development of atmospheric disturbances associated with land and sea surface temperature contrasts.

The western extension of the Azores-Bermuda high pressure cell dominates circulation throughout the year, weakening in winter and strengthening in summer. The average monthly pressure reaches a minimum of 1,014-1,016 millibars from west to east over the northern Gulf during the summer, but attains a maximum of 1,021 millibars during the winter. The minimum average monthly pressure occurs during the summer when the equatorial trough shifts northward. The maximum pressure occurs during the winter as a result of the presence and influence of continental cold air.

Air temperatures over the open Gulf exhibit narrower limits of variations on both a daily and seasonal basis. The average temperature over the center of the Gulf is about 29°C in the summer; winter temperatures average between 17°C and 23°C.

The relative humidity over the Gulf is high throughout the year. Minimum humidities occur during the late fall and winter when cold, continental air masses bring dry air into the northern Gulf. Maximum humidities occur during the spring and summer when prevailing southerly winds bring in warm, moist air.

Winds are more variable near the coast than over open waters because coastal winds are more directly influenced by the moving cyclonic storms that are characteristic of the continent and because of the sea and land breeze regime. The Azores-Bermuda atmospheric high pressure cell dominates circulation over the Gulf, particularly during the spring and summer months. In late summer there is a general northward shift of the circulation, and the Gulf becomes more directly influenced by the equatorial low pressure cell. During the relatively constant summer conditions, the southerly positions of the Azores-Bermuda cell generate predominantly southeasterly winds that become more southerly in the northern Gulf. Winter winds usually blow from easterly directions with fewer southerlies but more northerlies. "Northers" may occur some 15-30 times between November and March. Winds from the west and southwest are rare at anytime during the year.

Average annual precipitation along the Gulf Coast ranges between approximately 69 cm at Brownsville, Texas; 102 cm at Galveston, Texas; and 137 cm at New Orleans, Louisiana, and Fort Myers, Florida. Rainfall is fairly evenly distributed (except in the South Texas region) throughout the year, with the greatest amounts occurring during June, July, and August when the winds are predominantly out of the south and southeast.

Precipitation is frequent and abundant throughout the year but does show distinct seasonal variation. At New Orleans, October is the only month when precipitation averages less than 8 cm; July is the wettest month and receives just under 18 cm. Stations along the entire coast record the highest precipitation values during the warmer months of the year (USDC, 1967; Brower et al., 1972). The month of maximum rainfall is July. Snowfalls are rare, and when frozen precipitation does occur it usually melts upon contact with the ground. Incidence of frozen precipitation decreases with distance offshore and rapidly reaches zero.

Warm, moist Gulf air blowing slowly over chilled land or water surfaces brings about the formation of fog. Fog occurrence decreases seaward but visibility can become a serious problem due to offshore fog. Coastal fogs generally last three or four hours, although particularly dense sea fogs may persist for several days. Poorest visibility conditions occur during winter and early spring. The period from November-April has the highest frequencies of low visibilities. Visibility around the Mississippi Delta may be lowered by industrial pollution from New Orleans or burning marshlands.

The largest and most destructive storms affecting the Gulf of Mexico and adjacent coastal zones are tropical cyclones that have their origin over the warm tropical waters of the central Atlantic Ocean, Caribbean Sea, or southern Gulf of Mexico. Tropical cyclones occur most frequently between June and late October, and there is a relatively high probability that they will cause damage in the Gulf each year. These storms are categorized according to intensity and relative probability of occurrence in coastal areas by the National Weather Service.

Hurricanes vary considerably in intensity, track patterns, and behavior when crossing land. McGowen et al. (1970) explain that storm approach is marked by rising tides and increased wind velocities; generally, the longer a storm lingers in the Gulf, the larger the surge of water it pushes ashore as it approaches land. These storm tides are commonly higher in the bays than on Gulf sea beaches, although flooding and pounding waves affect both areas. There is no preferred approaching route of hurricane tracks (DeWald, 1980), although early season storms generally approach from the southeast while later ones are more out of the south. Most hurricanes form in tropical ocean areas; however, a few are generated in the Gulf of Mexico. From 1901-1971, seven hurricanes and seven tropical storms formed in the Gulf north of 25°N and east of 85°W.

Hurricane damage results from high winds and, particularly in the coastal areas, the storm surge or tide, which is an abnormally high rise in the water level (Visual No. 6). Maximum surge height at any location is dependent on many factors including bottom topography, coastline configuration, and storm intensity. The storm surge associated with Hurricane Betsy in 1965 reached nearly 6.1 m (20 ft) at Bayou Lafourche; however, Hurricane Carla in 1961 produced 7 m (23 ft) tides in Lavaca Bay, Texas. Hurricane Camille, until recently the most severe hurricane in recent Gulf history, attained top winds estimated at 324 km/hr (201 mph) with central barometric pressure as low as 68 cm (26.6 in) of mercury in late August 1977. Hurricane Gilbert, the most severe hurricane ever recorded in the Atlantic Basin, attained top winds estimated at 453 km/hr (281 mph) with central barometric pressure as low as 67 cm (26.28 in) of mercury in September 1988.

3. Physical Oceanography

The physical oceanography of the Gulf of Mexico is summarized on Visual No. 7. All references to figure numbers in this discussion refer to the figures on Visual No. 7. The description of physical oceanography is hereby incorporated by reference from Final EIS 113/115/116 (pages III-9 through III-12). Presented below is a summary of that material.

The Gulf of Mexico is a subtropical sea with an area of approximately 1.6 million km^2. Its continental shelf ranges in width from about 350 km offshore West Florida to about 20 km off the Mississippi River. The depth of the central abyss ranges to 4,000 m. The various physiographic regions of the Gulf basin were shown on Visual No. 9 of Final EIS 94/98/102.

The Gulf of Mexico has two entrances: the Yucatan Strait and the Straits of Florida. Twenty-one major estuaries are found on the U.S. coast, and a number of rivers, dominated by the Mississippi River, provide sufficient freshwater input so that the basin is classified a positive estuary. The Gulf also contains a portion of the Gulf Stream system; the parent Loop Current.

The Loop Current is a highly variable current feature entering the Gulf through the Yucatan Strait and exiting through the Straits of Florida after tracing an arc that may intrude as far north as the Mississippi-Alabama shelf. The Loop consists of ascending and descending 30-km wide bands of rapidly moving water enclosing a relatively quiescent inner region, and the entire feature may clearly be seen in hydrographic sections down to about 1,000 m. The volumetric influx of the Loop has been estimated at 30 million m^3/sec. Velocities up to 300 cm/sec have been measured, but a range of 100-200 is probably representative (Nowlin, 1972).

Due to its great variability, the location of the Loop Current is definable only in statistical terms. Figure 5A shows the relative existence probabilities for Loop Current water throughout the Eastern Gulf in March, the month of apparent greatest intrusion. The usual eddies are large, necessitating significant dimensional adjustment by the Loop (Figure 5C) after they are shed. Major Loop Current eddies have diameters on the order of 300-400 km. As seen in Figures 4A-4C, they move into the Western Gulf along various paths to a region between 25°N-28°N and 93°W-96°W. An average northern intrusion is indicated to 26.6°N, within a wide envelope. Figures 1A-1C illustrate the overall cycle, including the subsequent behavior of the eddies. The eddies move at a speed of about 5 km/day, decreasing in size as they mix with resident waters. The life cycle of an individual eddy, to its eventual assimilation by regional circulation patterns in the Western Gulf, is about one year.

Offshore northern Mexico and South Texas, a western boundary current occurs, driven both by prevailing winds and the semipermanent anticyclonic eddy. A strong northeasterly current along the remaining Texas and Louisiana slope has been explained partly by the effects of the semipermanent anticyclonic eddy and a partner cyclonic eddy ("modon pair") and partly by the mass balance requirements of the eddy movement.

West of approximately Cameron, Louisiana, current measurements clearly show a strong response of coastal current to the winds, setting up a large-scale cyclonic gyre. The inshore limb of the gyre is the westward or southwestward (downcoast) component, which prevails along much of the coast, except in July-August. A prevailing countercurrent toward the northeast along the shelf edge constitutes the outer limb of the gyre. The convergence at the southwestern end of the gyre migrates seasonally with the direction of the prevailing wind, ranging from a point south of the Rio Grande in the fall to the Cameron area by July. The gyre is normally absent in July, but reappears in August-September when a downcoast wind component develops (Cochrane and Kelly, 1986). On the Mississippi-Alabama shelf, the winter circulation is frequently a westward flow. During the summer, this flow is reduced or may reverse.

Sharp discontinuities at the sea surface, such as the Loop front or fronts associated with eddies or river plumes, are dynamic features in themselves that act to concentrate bouyant material such as spilled oil or plankton. The principal movement of these materials is lateral along the front. In addition to open ocean fronts, a coastal front is probably a permanent feature of the Gulf shelf, separating turbid, lower salinity water from the open shelf regime. Figure 7 indicates that the front lies about 30-50 km offshore. It is not known how strongly this front might affect buoyant material transport.

Figures 6A-6D show the seasonal mean winds from a multi-year analysis. A summary of significant wave height measurements is presented in Figure 6-G, and sea surface temperatures in the Gulf are shown in Figures 9A and 9B. Surface temperatures in the Gulf range from around 30°C in August to about 14°C-15°C in January in the coastal areas. At a depth of about 1,000 m, the temperature remains close to 5°C year-round.

4. Chemical Oceanography

The Gulf of Mexico is a semiclosed system with oceanic input through the Yucatan Channel and principal outflow through the straits of Florida. Runoff from approximately two-thirds of the area of the United States and more than one-half of the area of Mexico empties into the Gulf. This large amount of runoff with its nonoceanic composition is mixed into the surface water of the Western Gulf and makes the chemistry of parts of this system quite different from the open ocean. The central Gulf is most affected by runoff from the Mississippi River, as well as a host of other major drainage systems. The chemical oceanographic parameters affected are briefly discussed below. The description of chemical oceanography is hereby incorporated by reference from Final EIS 113/115/116 (pages III-12 through III-18). Presented below is a summary of that material.

Eight specific water masses common to the Western Atlantic Ocean are recognized to occur in the Gulf of Mexico and are generally stratified by depth. The characteristics of those water masses are summarized in Table III-1 of Final EIS 113/115/116.

The mixed layer in the open Gulf, extending down to a depth of approximately 100-150 m, is characterized by salinities between 36.4 and 36.5‰. Salinity values in shelf and estuarine regions may vary widely from this range due to the opposing effects of river input and enhanced evaporation. Alternating floods and droughts may cause salinity changes from nearly fresh to 100‰, three times that of normal seawater. These variations can lead to mass mortality of marine organisms (Caruthers, 1972; Corcoran, 1973; Nowlin, 1972; Williams, 1954).

Mixed layer temperatures in the Gulf range from 27°C in late winter to about 30°C in the summer in the Eastern Gulf, and from 22°C to 29°C in the Western Gulf (Corcoran, 1973; Dames and Moore, 1979; Flint and Rabalais, 1980; Ichiye et al., 1973; Nowlin, 1972; SUSIO, 1977, 1978; Williams, 1954; and Woodward-Clyde Consultants, 1982). Lowest values encountered may range as low as 10°C in the Louisiana-Mississippi shelf region due to extraordinary snow melt in the upper Mississippi valley.

Dissolved oxygen values in the mixed layer average about 4.6 ml/L, with a slight lowering during the summer months. Oxygen values generally decrease to about 3.5 ml/L with depth throughout the mixed layer (Caruthers, 1972; Corcoran, 1973; Nowlin, 1972; and Williams, 1954).

The three principal micronutrients present in the Gulf of Mexico are phosphate, nitrate, and silicate. In the mixed layer, phosphates range from 0 to 0.25 ppm both on the shelf and in the open Gulf. Nitrates average around 0.014 ppm with a range of 0.0031 to 0.14 ppm. Open Gulf values are slightly higher than shelf values. Silicates range from 0.048 to 1.9 ppm, with open Gulf values tending to be lower than shelf values. The micronutrients are vertically distributed with low concentrations in the mixed layer (to 100 or 200 m) and maximum values occurring at approximately 800-1,000 m. High nutrient concentrations also occur in the estuaries and nearshore off Louisiana.

In general, Louisiana's estuaries and near offshore waters are low in salinity and high in nutrient concentrations as compared with other states bordering the northern Gulf. These characteristics are due primarily to Louisiana's high rainfall and the large volume of river water that makes its way through rich alluvial soils to the Gulf of Mexico. The major contributors of nutrients to the estuaries are the Mississippi and Atchafalaya Rivers.

Within the nearshore area, sediment trace metal values may show high absolute concentrations or anomalous ratios due to their input on contaminated clays borne by the Mississippi River. Transition metals known to be used/disposed of during heavy industrial processes, such as mercury and cadmium, are likely contaminants.

The Mississippi River input acts to create a lens of fresher, more turbid water, often curling to the west. Hydrographic studies, suspended sediment characteristics, and sensitive chemical analyses demonstrate their influence as far west as South Texas. Of importance is the water-column stratifying effect of this fresh lens on nearshore waters. It is frequently observed during summer months, particularly August, that hypoxic bottom water conditions exist on the central Louisiana shelf in zones that may extend over 50 km along shore-normal transects. Mass mortality of organisms and characteristic chemical changes also occur. These conditions have serious implications for the continued viability of the local fisheries and for monitoring programs of any sort.

Open Gulf waters have particle contents ranging from about 0.1 to 0.2 ppm, with over 50% of the suspensate being organic in surface waters and decreasing to one-third in deeper waters. Higher values occur nearshore, particularly off Louisiana where effects of the Mississippi River outflow are most evident. Particulate values above 1 ppm are found in local near-bottom concentrations, particularly on the shelf. Typically, these turbid "nepheloid" layers may be associated with resuspension by swift-flowing bottom currents, with intense at-depth biological activity, or with a complex combination of both. Nepheloid layers appear to occur naturally at nearly all locations on the shelf and upper slope environment, excepting on the promontories of significant topographic highs.

Primary production, as measured by uptake of C^{14}, occurs predominately at the low level of 0.25 $mgC/m^3/hr$, or less, throughout the Gulf. Higher levels, between 0.25 and 1.0 units, are found at northeastern and southern locations, with maximum values found on the Yucatan shelf. Higher productivity levels are sustained at subsurface levels rather than at the surface (Barnard and Froelich, 1981; El-Sayed, 1972; Iverson and Hopkins, 1981; LaRock and Bittaker, 1973; and Williams, 1954).

The distribution of chlorophyll closely parallels that of productivity. Most values range from 0.05 to 0.30 mg/m^3, with the highest values found off the Mexican coast. As a probable consequence of the large fluvial input of nutrients, the Louisiana nearshore shelf is considered one of the most productive areas of phytoplankton in the Gulf. Integrated chlorophyll values are twice the average Gulf values, and integrated productivity values range an order of magnitude greater than the Gulf average. Offshore Texas, chlorophyll is highly correlated with salinity decreases, indicating the influence of riverine input. Most chlorophyll is found at the bottom of the water column on the Western Gulf shelf from the shore out to mid-shelf. Productivity on the outer shelf exhibits much less variability caused by riverine input. Aperiodic upwelling events are probably of primary importance in regulating offshore production on the outer shelf and slope of this area.

5. Water Quality

Water quality is based upon numerous factors, including currents, freshwater inputs, nature and number of discharges, outfalls, and human activities that consist of municipal and industrial waste discharges, runoff, oil spillage, dredging, etc. In the past, water quality has been defined as the degree to which chemical concentrations and physical parameters within a water mass approach the ambient water state.

a. Coastal/Nearshore

Coastal/nearshore water quality varies and is determined by river outflows into the Gulf. The Mississippi River has the greatest impact on the Gulf's water quality and is the most significant source of pollution to this area. As indicated by NOAA (USDC, NOAA, 1986), despite most Gulf coast estuaries being shallow and experiencing sufficient mixing to adequately oxygenate their waters, a number of studies indicate dissolved oxygen levels in these estuaries are becoming problematic. In recent years, numerous hypoxia and anoxia events have been documented throughout the northern Gulf coastal region. Low dissolved oxygen levels often indicate that nutrient levels are much higher than desired. Elevated nutrient levels can result in eutropication of water bodies, causing algal blooms and fish kills. Oxygen depletion normally occurs in the summer months in this region, resulting from reduced mixing in coastal waters. Reduced mixing leads to thermohaline stratification and, when combined with a source of oxidizable organic material, can lead to hypoxia or anoxia. The existing water quality of the coastal regions of the Central and Western Gulf is briefly discussed below.

The most significant contaminated water body in coastal Louisiana is the Mississippi River, which drains 41% of the lands of the continental U.S. Industrial outfalls, accidental spillage, and high volumes of vessel traffic result in the presence of high bacterial concentrations, volatile organics, and pollutants within the Mississippi River. The levee system surrounding the River, however, prevents much of these pollutants from entering surrounding coastal estuaries. Major contributions to water quality problems within the Louisiana wetlands stem from increased land-clearing activities resulting from agricultural and industrial expansions and urbanizations; associated dredging and disposal of dredged materials; wastes from domestic and industry sources; barge cleaning operations and other boating and vessel activities within coastal waterways; historical, extensive oil and gas industry operations; and erosional problems.

The Texas coastal area has been plagued with numerous water quality problems. Degradation of water quality has occurred from many sources, including domestic and industrial effluents, dredging operations, agricultural runoff, shipping, offshore operations, etc. The majority of these water quality problems occur in the Houston-Galveston and Beaumont-Port Arthur areas where the majority of Texas' energy facilities are located. Use of the Houston Ship Channel and the Sabine-Neches River complex as effluent-receiving systems has seriously impacted the water quality of these systems and the surrounding areas. However, an effort has been made in the last several years to clean up these systems by upgrading industrial and municipal waste treatment systems, hence lessening the water quality degradation experienced in the past. Although the area between Sabine Pass and Lavaca Bay has been beset by numerous water quality problems, the majority of Texas coastal river basins exhibit acceptable water quality (Texas Water Commission, 1986).

b. Offshore

Table III-2 of Final EIS 113/115/116 illustrates the range of values for water quality parameters measured in the Gulf of Mexico off Texas and Louisiana. Figures III-1 and III-2 in that same document denote sources of water pollution within Gulf coastal areas. Generally speaking, water quality of the open Gulf is very high. All parameters measured are typical of well-circulated oceanic environments. Offshore water quality degradation is associated primarily with effluent discharges by offshore enterprises, consisting of OCS activities and marine transportation sources. Fishing activities also cause degradation as trawling causes resuspension of sediments. The Gulf is a large body of water, however, and the effects of these activities can be observed only very near the activity and only for a short period of time. A complete description of offshore water quality may be found in Section III.A.5. above.

6. Air Quality

Air quality of the coastal area along the Gulf of Mexico is measured against the NAAQS resulting from the Clean Air Act, as amended. These standards are designed to preserve the air quality of an area at a threshold necessary to protect public health and welfare.

The ambient air quality in any area is determined by using special monitoring schemes (40 CFR 50) and is measured relative to NAAQS primary and secondary standards. Primary standards are designed to protect public health, and secondary standards are designed to protect public welfare. If a county or section of a county does not meet the primary and/or secondary standards, it is classified as nonattainment. Areas designated as Prevention of Significant Deterioration (PSD) areas are identified as mandatory Class I Federal areas, where visibility is an important value. These areas are national and international parks and wilderness areas.

Air quality in the coastal region of the Gulf is generally considered good and in many areas is better than the national standards. The two Alabama counties fronting the Central Gulf are attainment areas. Of the three coastal counties in Mississippi, all are attainment areas. Of the 14 coastal parishes in Louisiana, 7 are attainment areas; however, 7 parishes exceed primary standards for O_3. Of the 16 Texas coastal counties fronting the Western Gulf, 10 are attainment areas. Two counties exceed primary standards for total suspended particulates (TSP), and four counties exceed primary standards for O_3. Of these four, two also exceed standards for TSP. The status of air quality in the Central and Western Gulf is shown in Figure III-1.

The PSD Class I areas are located in two of the five Gulf coastal states: Florida and Louisiana. In Louisiana there is one PSD Class I area--Breton Wilderness Area. All five states have State Implementation Plans for air

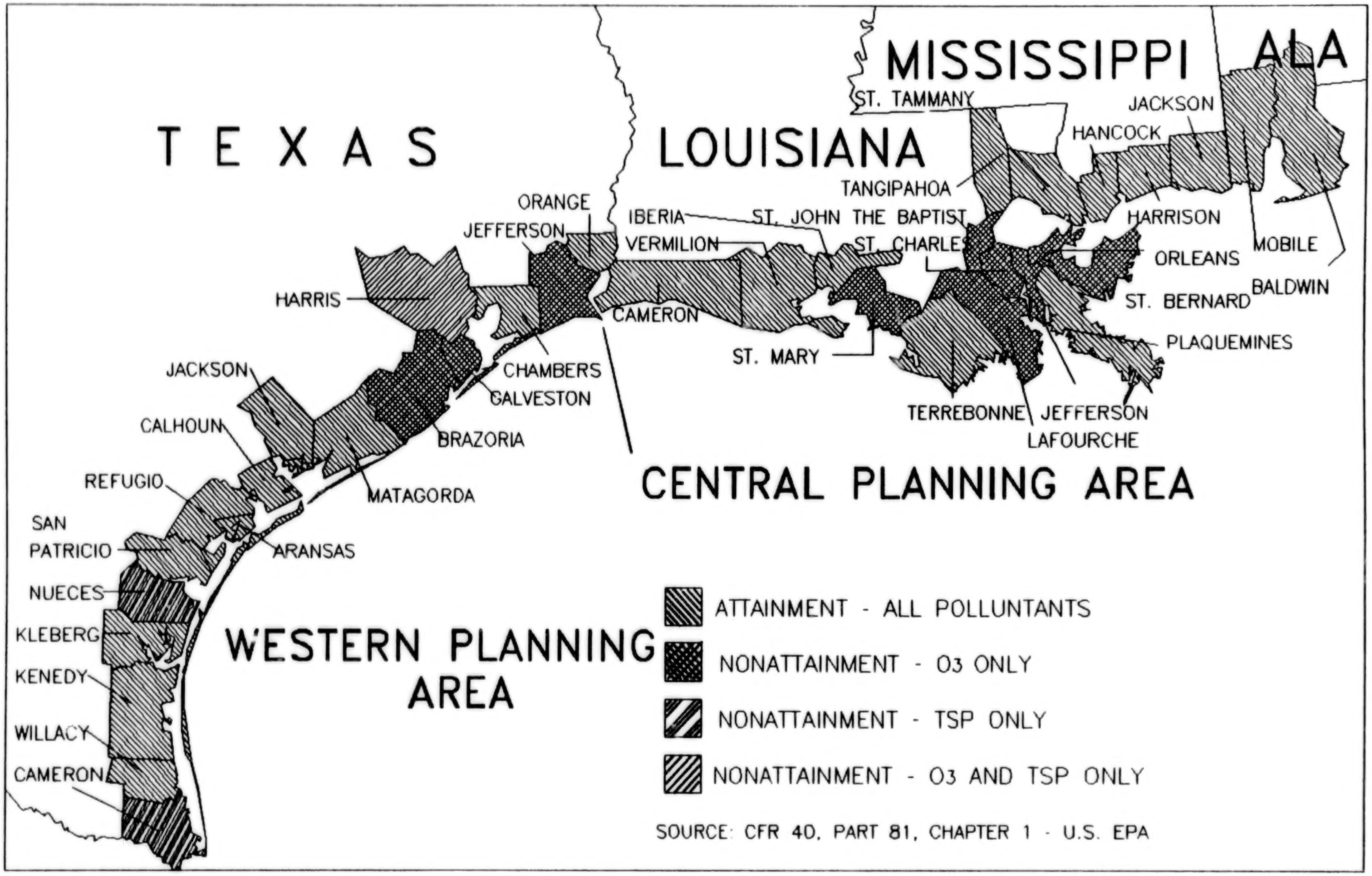


Figure III-1: Status of air quality in the Western and Central Planning Areas of the Gulf of Mexico Region

quality coupled with regulatory enforcement and monitoring programs in operation for bringing nonattainment areas into attainment.

Ambient air quality is considered to be a function of the size, distribution, and activity of a population and, more importantly, the industrialization of an area. Emissions from all sources, such as external combustion, solid waste incineration, internal combustion, evaporation, chemical processing, etc., make up the ambient air quality at any given time according to the particular rates of emission, proximity of emission sources, local meteorological conditions, and the rate of dispersion. These factors preclude the ambient air quality from remaining the same at all times and, in fact, work in unison such that peak and low conditions are observed as a function of time; i.e., at certain periods the controlling factors may cause the ambient air quality to meet or exceed NAAQS and at other times it may be far below. Meteorological conditions play a very important role in the dispersion of emissions and thus on the ambient air quality. Generally, long-range transport of emissions will cause worst-case onshore conditions when a plume is traveling in a stable or neutral layer over water, when the winds are persistent in reaching shore, and when unstable daytime conditions occur over coastal areas. These conditions are rare in the coastal Gulf regions due primarily to prevailing climatological and physiological characteristics.

B. BIOLOGICAL RESOURCES

1. Coastal Habitats

a. Coastal Barriers

Coastal barrier landforms consist of islands, spits, and beaches that stretch in an irregular chain from Florida to Texas as shown on Visuals Nos. 4 and 4E. These elongated, narrow landforms are composed of sand and other unconsolidated, predominantly coarse sediments that have been transported and deposited by waves, currents, storm surges, and winds. Barrier landforms are young coastal features. They began to form 5,000 to 6,000 years ago after the main mass of continental ice sheets had melted and the global rate of rise of sea level began to slow.

The term "barrier" identifies the structure as one that protects other features, such as bays, lagoons, estuaries, and marshes, from the direct impacts of the open ocean. By separating coastal waters from the ocean, barriers contribute to the amount of estuarine habitat available along the coast. As much as two-thirds of the top value Atlantic and Gulf species of fish are considered to be directly dependent during some stage of their life on conditions in an estuary (Clark, 1976). Another benefit of both the barriers and their adjacent marshes and bays is that of providing habitats for a large number of birds and other animals, including several threatened or endangered species, such as the loggerhead turtle, the southern bald eagle, alligators, and brown pelicans.

Barrier landforms are relatively low land masses that are continually adjusting their configuration in response to changing environmental conditions. Landform changes can be seasonal and cyclical, such as the transition from a summer (or swell) beach to a winter (or storm) beach, or they can proceed in one direction, such as a net landward or longshore drift of a feature. The long-term survival of fixed structures, such as roads, buildings, and power lines, constructed on a barrier landform can often be jeopardized by the changing and migratory nature of the barrier features.

Some types of construction or stabilization projects on barrier landforms may actually encourage erosion, especially when the project interferes with longshore or shore-normal sediment movements. The MMS has funded a study entitled *Impacts of OCS-Related Activities on Sensitive Coastal Habitats* to examine the impacts of pipeline and navigation canal installations on barrier islands in the Western and Central Gulf of Mexico.

Barrier landforms in the Central and Western Gulf fall into three physiographic categories, which correspond to the three states that border this part of the Gulf. These are the Mississippi, Louisiana, and Texas barriers. Much of the following discussion is taken from the USDI's *Coastal Barrier Resources System - Draft Report to Congress*, April 1985.

Most of Mississippi's barrier islands are part of the Gulf Islands National Seashore. These islands are relatively young, having formed some three to four thousand years ago as a result of shoal bar aggradation (Oetvos, 1979). The islands are well vegetated by a southern maritime climax forest of pine and palmetto. The islands generally have high beach ridges yet may be overwashed by strong storms. All are moving towards the west at a rapid rate in response to the westward littoral drift that is generated by the predominantly south-southeast winds that occur offshore.

Louisiana has the most rapidly retreating beaches in the nation. The average retreat rate for Fourchon Beach over the past 100 years has been in excess of 60 ft/yr. The statewide average exceeds 12 ft/yr (Dolan et al., 1982). Beaches along the deltaic plain in Louisiana fit into one of three categories, depending on the stage of the deltaic cycle that the nearby landmass is experiencing. When a major distributary of the Mississippi River is abandoned, subsidence results in a local sea level transgression that transforms the active delta into an erosional headland with flanking barriers. Fourchon Beach is an example of an eroding headland beach. With increased age and subsidence, the barrier shoreline evolves into a transgressive barrier island arc that is separated from the mainland by a lagoon. Isles Derniers is an example of a barrier that underwent the transformation from a headland beach to a barrier arc within the past century. Eventually, with continued subsidence and sediment deprivation, the island ceases to exist, its remnant forming a submarine inner-shelf shoal (Penland and Boyd, 1985).

The Chenier Plain is located further to the west in Louisiana. Here the coast is fronted by mudflats rather than the usual sandy beaches. The source of the mud is the discharge of the Mississippi River, which tends to drift westward along with the prevailing winds and associated nearshore currents. Fluid mud extends from the seaward edge of the marsh grasses to a few hundred yards offshore. The mud is an extremely effective wave-energy absorber. Consequently, the mainland shore is rarely exposed to effective wave action except during storms.

The Texas coast is a continuous barrier shoreline. The barrier islands and spits were formed from sediments supplied from three deltaic headlands: the Trinity delta in Jefferson County immediately west of the Sabine River; the Brazos-Colorado Rivers delta complex in Brazoria and Matagorda Counties; and the Rio Grande delta in southernmost Cameron County.

The Texas barriers are arranged symmetrically around these erosional deltaic headlands. Erosional and accretionary barriers are about evenly split. Accretionary barriers occur on either side of retreating deltaic headlands and tend to be wide, to have prominent vegetated dunes, and to contain few, if any, washover channels. Accretionary barriers grade into erosional barriers within interdeltaic embayments. Erosional barriers tend to be narrow, sparsely vegetated, and have a low profile and numerous washover channels.

Climate is an important variable that affects the Texas coast. Texas is the only Atlantic or Gulf State with a significant climate range. The climate changes from humid-subtropical in the east to semiarid in the south. South of Corpus Christi the annual evaporation exceeds the precipitation, and the landscape has an arid appearance. On high-profile, southern barriers, vegetation is sparse, and continuous winds have built high dunes.

b. Wetlands

The description of wetlands is incorporated by reference from Volume 1 of the Final Regional EIS (pages 167-173). A summary of that material is presented below. As depicted on Visuals Nos. 4 and 4E, wetland habitat types that occur along the Gulf Coast include mangroves, nonforested wetlands (fresh, brackish, and saline marshes), sandy beaches, and forested wetlands (bottomland hardwoods, cypress-tupelogum swamps, and tropical hardwood hummocks). Marshes and mangroves form an interface between marine and terrestrial habitats, while forested wetlands occur inland from marsh areas. Wetland habitats may occupy narrow bands or vast expanses and can consist of sharply delineated zones of different species, monotonous stands of a single species, or mixed plant species communities.

Louisiana contains most of the Gulf coastal wetlands. These wetlands occur in two physiographic settings: the Mississippi River Deltaic Plain and the Chenier Plain. The present wetlands on the deltaic plain formed on top of a series of overlapping riverine deltas that have extended onto the continental shelf during the past 6,000 or so years. These wetlands are established on a substrate of alluvial and organic-rich sediment that is subject to high, natural-subsidence rates. The effects of subsidence are compounded by sea level rise, which has been occurring during the past several millenia. Under natural conditions, sedimentation encourages vertical accretion of wetland areas and may offset the submergence and inundation that result from subsidence and sea level rise. Areas of the deltaic plain that are located near an active channel of the Mississippi River tend to build outward and marsh areas tend to expand, while at the same time, areas located near inactive, abandoned channels tend to deteriorate and erode as a result of lack of sediment.

The Chenier Plain, located to the west of the Atchafalaya Bay in the western part of coastal Louisiana, is a series of separate ridges of shell and sand, oriented parallel or oblique to the coast, that are separated by progradational mudflats that are now marshes or open water. The mudflats are built during times when the Mississippi River channel is located on the western side of the deltaic plain and longshore currents carry reworked alluvial sediments westward.

The deterioration of coastal wetlands, particularly in Louisiana, is an issue of concern. In Louisiana, the annual rate of wetlands loss has been measured at 50 square miles for the period 1955-1978. Several factors contribute to wetlands loss in coastal Louisiana including sediment deprivation (a result of a 50% decrease in the suspended sediment load of the river since the 1950's and the channelization of the river, which has prevented overbank sediment deposition), subsidence and sea level rise, and the construction of pipeline and navigation canals through the wetlands.

A recent study funded by MMS entitled *Causes of Wetland Loss in the Coastal Central Gulf of Mexico* (Turner and Cahoon, 1988) investigated how wetland habitats have changed in the northern Gulf of Mexico as a result of natural processes and human activities. The study's primary focus was on assessing and quantifying the direct and indirect impacts of OCS-related activities on wetland areas since the 1950's when OCS activities began in the Gulf region. Canal construction for pipelines and navigation has been the major OCS-related impacting factor.

Direct impacts were defined as those physical alterations that are the direct result of canal construction. Direct impacts include wetlands alterations that are the result of the actual dredging of the canal, the disposal of dredge spoil, and any subsequent widening of the canal as a reult of channel bank erosion. Based on the study's findings, OCS-related direct impacts have accounted for 16% of all the direct impacts that have occurred in Louisiana's wetlands (12,000 ha out of 74,000 ha). Direct OCS impacts account for only 4%-5% of the total wetlands loss during the period 1955/56 to 1978. The average areal impact per kilometer of constructed pipeline was estimated at 2.5 ha. In recent years, more stringent construction regulations have required that pipelines installed across wetlands be backfilled with spoil material immediately after the pipeline is installed in its ditch. The study showed that the backfilling of pipeline canals reduced direct impacts to 0.7-1.0 ha/km. Direct impacts per unit length of OCS-related navigation canals are about 20 times greater than OCS pipeline canals.

Indirect impacts are those that occur as a result of hydrologic changes (salinity and drainage regimes) brought on by canal construction. Indirect impacts can be propagated away from the immediate area of the canal impact (as a result of the backwater effects of the hydrologic alterations) and they can occur over long time periods. Indirect impacts interact with the other factors that contribute to wetlands loss (sediment deprivation and submergence) in such complex and synergistic ways that it will be difficult to quantify their magnitude with great precision. The MMS-funded study concluded that the indirect impacts of OCS activities account for 4%-13% of all indirect impacts and that indirect impacts account for 20%-60% of the total amount of wetlands loss. The report cautions, however, that these numbers are based on the interpretation of limited data and should be used with caution to indicate only the relative magnitudes of possible impacts.

In Texas, coastal marshes occur along the inshore side of barrier islands and bays and on river deltas. Salt marshes consisting primarily of smooth cordgrass occur at lower elevations and at higher salinities. At higher salt marsh elevations, typical vegetation includes saltgrass, glasswort, shoregrass, and maritime saltwort. Sparse bands of black mangroves are also found in this region. Brackish marshes are characterized by vegetation consisting of coastal sacahuista, matchhay cordgrass, big cordgrass, saltgrass, bulrush, and narrow-leaved cattail. Freshwater marshes of the region occur primarily along the major rivers and tributaries. These marshes are comprised of common reed, Jamaica sawgrass, bulrush, sloughgrass, and common cattail.

The importance of coastal wetlands to the coastal environment has been well documented. Coastal wetlands are characterized by high organic productivity, high detritus production, and efficient nutrient recycling. Wetlands provide habitat for a great number and wide diversity of invertebrates, fish, herptiles, birds, and mammals. Wetlands are particularly important as nursery grounds for juvenile forms of many important fish species. The Louisiana coastal wetlands support over two-thirds of the Mississippi Flyway wintering waterfowl population (including 20%-25% of North America's puddle duck population) and the largest fur harvest in North America (from 40% to 65% of the nation's total per year) (Olds, 1984).

c. Seagrasses

There are an estimated 3.7 million acres of submerged seagrass beds in the shallow coastal waters of the Gulf. The area off Florida contains the vast majority of such beds, containing appproximately 90% of all coastal seagrasses in the Gulf of Mexico. Coastal seagrass beds in Texas, Louisiana, Mississippi, and Alabama comprise approximately 8%, 0.5%, 0.5%, and 1%, respectively of the remaining habitat. A combination of low salinity and high turbidity account for the narrow bands and scattered patches of seagrasses occurring between Louisiana and Laguna Madre, Texas. Percentages listed above are derived from acreage estimates which can be found in the Final

Regional EIS (USDI, MMS, 1983a) in Volume 1, Section III.B.1. and on Visual No. 14 of the Final Regional EIS. Visual No. 14 also displays generalized seagrass bed locations.

Subaqueous spermatophytes, commonly called seagrasses, have many important ecological functions and are an important component of the coastal ecosystem. Seagrass beds provide sediment stabilization by increasing sedimentation of suspended sediments, which also serves to provide clearer water over the top of the beds. They provide nursery habitat and shelter for the young of commercially and recreationally important species of fish and shellfish, and attract a diverse and prolific epiphytic biota, serving as sites of attachment for many mollusks and often creating unique habitat for the existence of certain species. Seagrasses contribute oxygen and nutrients to the water column and serve as both direct and indirect food sources for many marine species. The beds grow in shallow, relatively clear and protected waters with predominantly sand bottoms. Their distribution depend on an interrelationship among a number of environmental factors, including temperature, water depth, turbidity, and salinity.

There are seven areas in Louisiana coastal waters where habitat conditions are favorable for the establishment of submergent marine grasses. The turbid waters and soft sediments of Louisiana's estuaries limit more widespread distribution. These areas include: the bay side of Isle Dernieres, Timbalier and East Timbalier Islands; along the north shore of Lake Pelto, Old Lady Lake, and the southeastern shore of Timbalier Bay; the western side of the Chandeleur Islands; the southwestern corner of Lake Salvador in Temple and Catahoula Bays; and, further north, scattered patches exist in Lakes Catherine, Pontchartrain, and Maurepas. Species most commonly found include turtle grass *(Thalassia testudinum)*, shoal grass *(Halodule writhtii)*, manatee grass *(Cymodoea manatorum)*, Gulf Halophia *(Halophila engelmanni)*, and Syringodium *(Syringodium filiforme)* (Burk & Associates, 1977).

Seagrasses dominate the aquatic flora habitat in the estuarine communities along the Texas coast. Dominant species include shoal grass *(Halodule beaudettei)*, widgeongrass *(Ruppia maritima)*, turtle grass *(Thalassia testudinum)* and manatee grass *(Cymodocea filiformis)*, with the first two species listed in greatest abundance due to their ability to sustain salinity variations that occur in a number of the lagoon and bay systems of Texas. The Laguna Madre and Copano-Aransas estuaries account for the major portion of the seagrass populations, while in Corpus Christi Bay, seagrasses are less common due to the Bay's greater water depth. These seagrasses provide an important habitat for immature shrimp, black drum, spotted seatrout, juvenile southern flounder, and several other fish species, and they provide a food source for several species of wintering waterfowl.

2. Offshore Habitats

The description of offshore habitats of the Gulf of Mexico is hereby incorporated by reference from Volume 1 of the Final Regional EIS (pages 172-182) and Final EIS 113/115/116 (pages III-30 through III-44). Presented below is a summary of that material. Stipulations designed to protect those offshore habitats sensitive to oil and gas activities are discussed in Sections II.A.1.c.(1) and (2) and II.B.1.c.(1). The following discussion is a summary of the information documented in the cited EIS's, updated or expanded, as appropriate.

The term "offshore habitats" refers to the water column and the seafloor. These habitats are discussed generally for each of the regions of the Central and Western Gulf. Particular emphasis is given to the benthos since those biota are most likely to be affected by oil and gas operations.

Shelf

Water column biota are divided into plankton and nekton, but generalizations about the biota of the water column are not possible because of the patchy nature of distribution. Plankton are distributed in patches of various sizes that move with the prevailing winds and currents. In general, planktonic species diversity decreases with decreased salinity, and biomass decreases with distance from shore.

Nekton are represented by five major taxonomic categories--marine mammals, reptiles, fishes, cephalopod mollusks, and crustaceans. Individuals commonly range over broad areas; however, most nekton are limited to geographical and vertical ranges by the same environmental conditions as less motile organisms, i.e., temperature, salinity, and available food. Most of the fishes are temperate, with incursions of Caribbean faunas; they exhibit seasonal distribution and abundance fluctuations that are probably largely related to oceanographic conditions.

The benthos has both floral and faunal components, the floral representatives being algae and seagrasses. The abundance of benthic algae is limited by the scarcity of suitable rocky substrates and light penetration. Rezak et al.

(1983) recorded algae from submarine banks off Louisiana and Texas. In exceptionally clear waters, benthic algae, especially coralline red algae, are known to grow in water depths up to at least 183 m. Offshore seagrasses are not conspicuous in the Central and Western Gulf; however, fairly extensive beds may be found in estuarine areas behind the barrier islands throughout the Gulf as discussed in Section III.B.1.c. Seagrasses would be continuous around the entire periphery of the Gulf if it were not for the adverse effects of turbidity and low salinity of the Mississippi River effluent from the delta to Galveston (Humm, 1973).

Benthic fauna include the infauna (animals that live in the substrate such as burrowing worms and mollusks) and epifauna (animals that live on the substrate such as mollusks, crustaceans, hydroids, sponges, and echinoderms). Shrimp and demersal fish are closely associated with the benthic community. Substrate is the single most important factor in the distribution of benthic fauna (Defenbaugh, 1976). Temperature and salinity are also important in determining the extent of faunal distribution. Other lesser important factors include illumination, exposure to air, nutrient availability, currents, tides, and wave shock. Defenbaugh (1976) states that depth and/or distance from shore should also be considered as major influences on the benthic faunal distribution.

The demersal shelf fauna fall naturally into four basic classes: nearshore, midshelf, outershelf, and transshelf groups. The demersal fauna exhibit coastal distribution patterns such as regional dominance, aggregation off passes, population insularization off Texas, and seasonal concentration near the Mississippi and Rio Grande River mouths. In the demersal fauna, seasons of peak abundance differ from species to species, with spring having the fewest and fall the most species showing peaks. Seasonality in distributional expansion, high density, rareness or absence, and depth-related shifts in distribution or density also occur (Darnell et al., 1983).

The Mississippi-Alabama shelf edge in the northeastern portion of the Central Gulf exhibits a band of pinnacles, the "pinnacle trend," between 220 and 360 ft depth. The pinnacles appear to be dead reefal structures (Ludwick and Walton, 1957). They were photographed in 1985 by CSA, which described the biota on the pinnacles as similar to the transitional antipatharian zone assemblage described by Rezak (CSA, 1985). These pinnacles may provide structural habitat for a variety of pelagic fish. The MMS, through the studies program, is funding a study entitled "Mississippi-Alabama Marine Ecosystem Study" to ascertain the extent and importance of the pinnacle area. Initial progress reports of this study may be found in Proceedings . . . (1988, pages 100-108) and USDI, MMS (1988d, pages 43-45).

The substrate in waters shallower than 220 ft (north of the pinnacle trend; in general, the northern portion of the Viosca Knoll leasing area) is a mixture of mud and/or sand (Vittor and Associates, 1985). The live bottom surveys required by MMS and conducted in this area reveal sand or mud substrate. These areas are not conducive to "live bottom" community growth since a hard substrate is needed for epifaunal attachment. As the substrate grades to carbonate sand in the Eastern Gulf, the potential for "live bottoms" increases.

The shelf and shelf edge of the Central and Western Gulf are characterized by topographic features that are inhabited by benthic communities (Figure III-2). The habitat created by the topographic features is important in several respects: they support hard-bottom communities of high biomass, high diversity, and high numbers of plant and animal species; they support, either as shelter, food, or both, large numbers of commercially and recreationally important fishes; they are unique to the extent that they are small isolated areas of such communities in the vast, relatively monotonous Gulf of Mexico of much lower biomass and diversity; they (especially the East and West Flower Garden Banks) provide a relatively pristine area suitable for scientific research; and they have an aesthetically attractive intrinsic value.

The benthic organisms on these features are temperature and light limited. The 16°C-isotherm is stressful for most coral and is considered the lower limit for coral growth (Rezak et al., 1983). Elevated temperatures can also cause thermal stress by causing the corals' zooxanthellae to be expelled.

Where light is limited, coral growth is inhibited. Therefore, coral growth is limited by water depth and by distance from surrounding substrate and nepheloid layer. Because the coral communities must be close enough to the surface of the water for adequate light penetration and yet removed from the seafloor to escape the effects of the nepheloid layer, the topographic features (or banks) present the proper conditions for coral growth.

Rezak et al. (1983 and 1985) identified seven distinct biotic zones on the banks of the Gulf. None of the banks contains all of the seven zones. Summary descriptions of these zones may be found in Final EIS 113/115/116.

Of the topographic features depicted in Figure III-2, 16 are located in the Central Gulf:

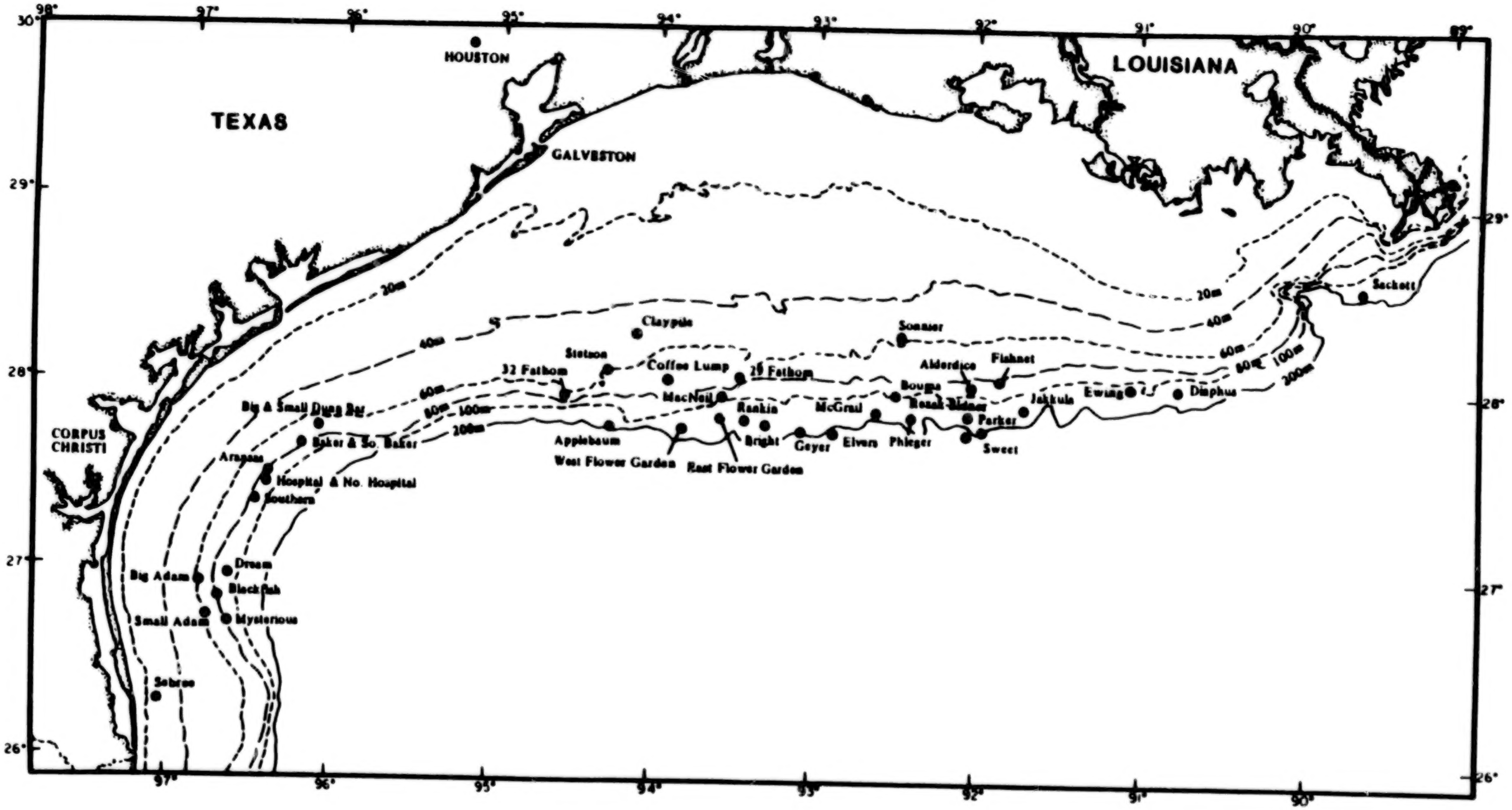


Figure III-2: Location of topographic features.

Shelf Edge Banks

Bright Bank
McGrail Bank
Rankin Bank
Alderdice Bank
Rezak Bank
Sidner Bank
Ewing Bank
Jakkula Bank
Bouma Bank
Parker Bank
Sackett Bank
Diaphus Bank
Sweet Bank

Midshelf Banks

Sonnier Bank
29 Fathom Bank
Fishnet Bank

(Rankin and 29 Fathom Banks are located along the dividing line between the Central and Western Gulf and, therefore, are considered on both.)

The shelf edge banks generally exhibit the zonation exhibited at the Flower Garden Banks at comparable depths.

Three of the Central Gulf banks are classified as midshelf banks: Sonnier, 29 Fathom, and Fishnet Banks. Because of their midshelf location resulting in lowered light penetration and temperature minimum, the biotic zones do not correspond to the same zones at similar depths on the Flower Gardens. Instead of the high diversity coral reef zone found at the Flower Gardens, the midshelf banks at similar depths exhibit the lower diversity *Millepora*-sponge zone. This zone is evident at Sonnier Bank in the Central Gulf. (Sonnier Bank was inadvertently left off Visual No. 3. Figure III-3 depicts the location of Sonnier Bank in relation to the lease blocks and the protective zonation locations in the Topographic Features Stipulation proposed for Sale 123 (Section II.A.1.c.(1)).

Of the topographic features depicted in Figure III-2, 27 are located in the Western Gulf:

Shelf Edge Banks

East Flower Garden Bank
West Flower Garden Bank
Geyer Bank
Rankin Bank
Elvers Bank
MacNeil Bank
Applebaum Bank
Phleger Bank

Midshelf Banks

Claypile Lump
32 Fathom Bank
Coffee Lump
Stetson Bank
29 Fathom Bank

South Texas Banks

Sebree Bank
Big Dunn Bar
Small Dunn Bar
Big Adam Bank
Small Adam Bank
Blackfish Ridge
Mysterious Bank
Baker Bank
Aransas Bank
Southern Bank
North Hospital Bank
Hospital Bank
South Baker Bank
Dream Bank

The shelf edge banks generally exhibit the zonation exhibited at the Flower Garden Banks at comparable depths. Of interest is Geyer Bank, which crests at 37 m, within the depth that the high-diversity coral reef zone is expected. However, at this bank, the *Millepora*-sponge zone is evident. The Millepora-sponge zone is found elsewhere in the Gulf only at the midshelf banks.

Three of the midshelf banks contain the *Millepora*-sponge zone: Sonnier Bank in the Central Gulf and Stetson and Claypile Banks in the Western Gulf. Claypile Bank, with only 10 m of relief, is considered a low relief bank

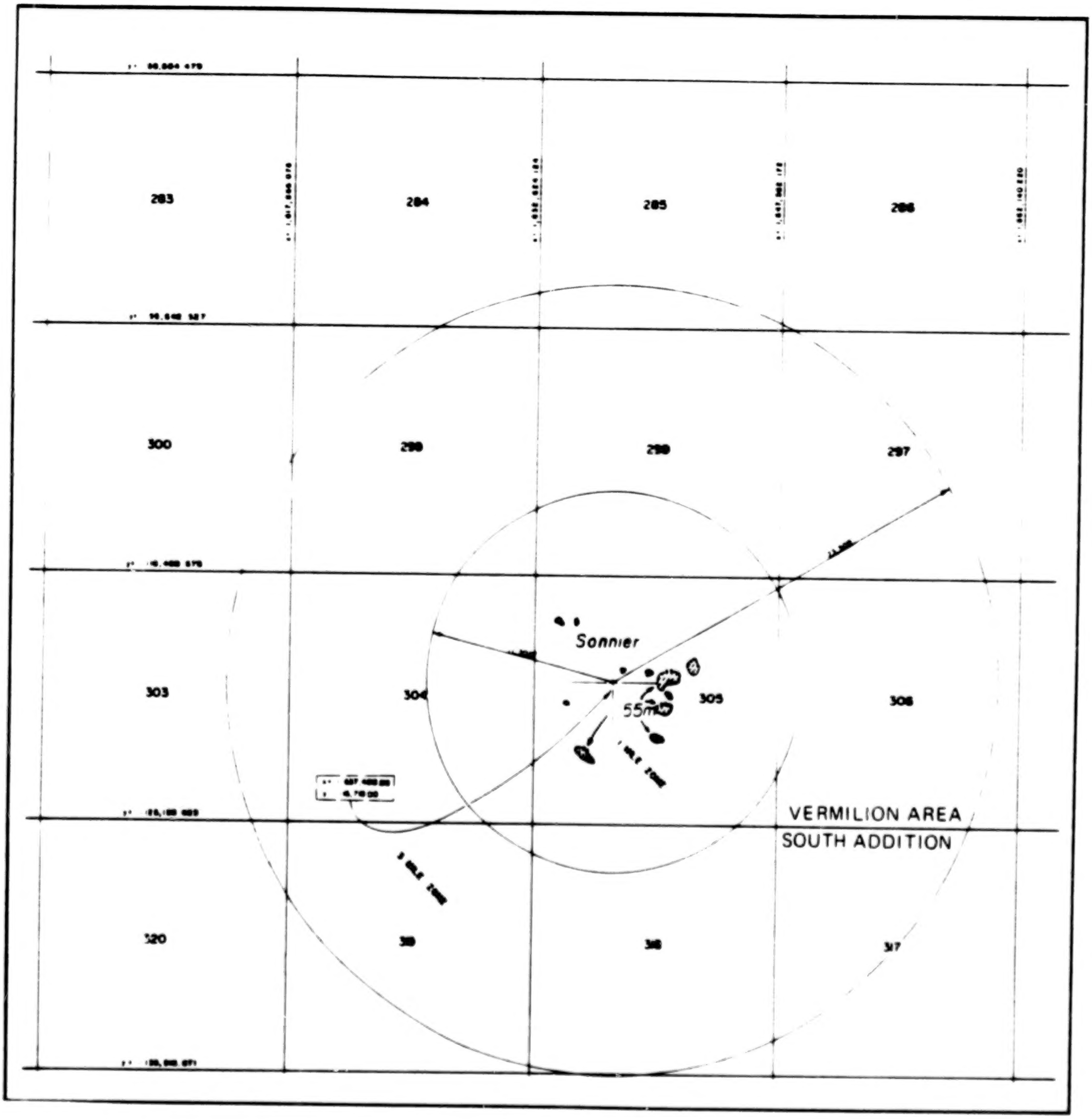


Figure III-3: Sonnier Bank and protective zones as proposed by the biological lease stipulation.

and is often enveloped by the nepheloid layer. Thus, the level of development of the *Millepora*-sponge community is lowest at Claypile Bank. Two other midshelf banks on the Western Gulf have reliefs less than 10 m and are considered low relief--32 Fathom Bank and Coffee Lump.

The South Texas banks are geographically/geologically distinct from the shelf edge banks. Several of the South Texas Banks are also low-relief banks, which have relatively low relief, have few hard-substrate outcrops, exhibit a reduced biota, and have a thicker sediment cover than the other banks.

Slope and Deep Sea

The deep-sea area of the northern Gulf of Mexico is much less known than the shelf. Pequegnat (1983) reported observations based on 264 oceanographic stations between 150 and 3,850 m in an area including the DeSoto and Alaminos Canyons, the Mississippi Trough and Fan, and the Sigsbee Abyssal Plain. There are some remarkable biotal differences in the deep ecosystem of the Gulf. In fact, the biotal differences justify referring to the Western Gulf (corresponds to WPA and CPA) as the "true" Gulf and the Eastern Gulf as a divergence of the Atlantic Ocean via the Caribbean Sea (Pequegnat, 1983; LGL Ecological Research Associates, Inc. and Texas A&M University, 1986).

Beneath the euphotic zone and extending to within a meter or so of the bottom is a huge mass of water that beyond the shelf is largely devoid of sunlight. This is the aphotic zone where photosynthesis cannot occur and where the processes of food consumption, biological decomposition, and nutrient regeneration take place in the cold and dark waters. The lowermost layer is the bottom itself together with the contiguous water a meter or so in thickness. This is the benthic zone, repository of sediments from above, where nutrient storage and regeneration take place in association with the solid and semi-solid substrate (Pequegnat, 1983).

The slope is a transitional environment influenced by processes on the shelf and the abyssal Gulf. This transition applies more to the pelagic than to the benthic realm. The general conclusions that may be reached are as follows: (a) the shelf phyto- and zooplankton are more abundant, more productive, and seasonally more variable than the open Gulf plankton; (b) in these respects, the slope plankton are intermediate but closer to the condition of the open Gulf; and (c) each of the three regions is characterized by some species that are more or less specific to the particular zones. Some east-west differences have been noted, especially among the diatom species. These species have also been interpreted as representing the differences between normal Gulf waters and those influenced by Mississippi River water (Pequegnat, 1983).

Most of the benthic fauna of the deep slope and abyssal plain are not found elsewhere. The 250-m isobath defines the truly deep sea fauna. The deepwater benthic fauna have been characterized into seven faunal assemblages by Pequegnat (1983) and confirmed by LGL Ecological Research Associates, Inc. and Texas A&M University (1986). These are summarized in Final EIS 113/115/116.

Chemosynthetic clams and tube worms have recently been discovered in the deep waters of the Gulf and have been the subject of numerous MMS site-specific reviews. These cold water communities are associated with seismic wipe-out zones and hydrocarbon seep areas between water depths of 400 and 1,000 m (Kennicutt and Gallaway, 1985). In late 1984, chemosynthetic communities were discovered in the Green Canyon Area of the Central Gulf at ambient temperatures at about 300-m water depth. Representatives from the genus *Calyptogena*, probably *C. ponderosa*, were identified from the Gulf seep communities. Chemosynthetic worms from the family *Lamellibrachiidae* and a new undescribed family were found in the Gulf seep communities. The seep communities are characterized by white organic mats, large dense beds of clams and mussels, numerous small gastropods and galatheid crabs (Kennicutt and Gallaway, 1985; LGL Ecological Research Associates, Inc. and Texas A&M University, 1986).

After the initial discovery of the chemosynthetic organisms in the Central Gulf, 12 trawls were conducted by Texas A&M University in the Green Canyon Area in 300-500-meter water depth. Chemosynthetic organisms were collected at the majority of these trawl transects. Additionally through separately funded studies, phototransects documented the location of chemosynthetic organisms at various widespread locations in the Green Canyon Area in water depths from 450 to 950 m. The Offshore Operators Committee funded a study through Texas A&M University (Brooks et al., 1986) to determine the extent of these communities in the Gulf and their correlation with hydrocarbon seepage. This study included 39 stations located between 180- and 900-m water depth and included the East Breaks, Garden Banks, Green Canyon, Ewing Bank, Atwater Valley, and Mississippi Canyon lease areas. Thirty of the stations sampled shallow seismic wipe-out zones. (Wipe-out zones are characteristic of gas-charged, hydrate-containing, and oil-stained sediments.) Of the 39 stations sampled, 28 yielded chemosynthetic organisms.

Only two of the nonchemosynthetic stations exhibited conditions where chemosynthetic communities might be expected, i.e., wipe-out zones, oil-stained sediments, gas pockets, or sediment H_2S odor. The study indicates that there is a strong correlation between seismic wipe-out zones and the occurrence of chemosynthetic communities. Additionally, the communities are widespread throughout the broad study area (Brooks et al., 1986). Texas A&M had documented widespread occurrence of shallow seismic wipe-out zones throughout the northern Gulf. Chemosynthetic organisms can be expected to occur on or near these wipe-out zones throughout the Central and Western Gulf where water depths are comparable to the study area.

In late 1986, LGL Ecological Research Associates, Inc., and Texas A&M University conducted further surveys as part of the MMS deep-sea study using the research submersible *Johnson-Sea Link I*. The surveys discovered a surprisingly large and diverse community of chemosynthetic tube worms and mussels at a site of natural petroleum and gas seepage in Green Canyon Block 185. The seep site, dubbed Bush Hill, is a small knoll in 1,800-ft water depth. The tube worms and mussels covered the top of the knoll over an area of 300 by 400 yds. The following description of this community was taken from an October 6, 1986, press release by LGL Ecological Research Associates, Inc:

> Tube worms formed bush-shaped formations of several hundred individuals, each of which was tipped with a bright red plume. A scallop-like bivalve, *Acesta bullisi*, often clung to the tube worms' plumes in an apparent example of mutualism. Dense beds of mussels clustered in and around the tube worms. Brightly-colored mats of bacteria appeared to float on layers of flocculent sediments. Samples of sediment oozed oil that hindered attempts to sieve out smaller burrowing organisms. Crabs and fish were abundant throughout the community.
>
> The density of the Bush Hill community is very atypical for the Gulf of Mexico continental slope. After diving on Bush Hill, the *Johnson-Sea Link I* surveyed a similar knoll about 20 miles away, but found only a few isolated tube worms. These findings indicate that hydrocarbon seepage can support much larger communities than previously thought possible.

Chemosynthetic communities have been a source of controversy over the past few years, in part because of the unusual environmental requirements and the hypothesized sensitivity of the communities to oil and gas activities. The MMS requires site-specific surveys of bottom-disturbing actions in water depths greater than 400 m in order to judge the potential of the region for supporting chemosynthetic organisms. Figures III-4 and III-5 delineate the regions of the Gulf of Mexico in which these reviews has been made. The review of site-specific activities has been accomplished since 1984, with over 80 blocks examined to date. The NTL, which formalized the process and its effects, may be found in Appendix E.

3. Endangered and Threatened Species

Six Federally listed endangered whale species may occur in the Gulf of Mexico--the blue, fin, humpback, right, sei, and great sperm whales. Usually, these large cetaceans inhabit the continental slope and deep oceanic waters; occasionally, they are sighted nearshore (Schmidly, 1981; Loeheffner, 1988). Five of the northern Gulf of Mexico endangered whales are baleen whales; the sixth, the sperm whale, is a toothed whale (Table III-1). Most baleen whales do not exhibit well-defined social or schooling structure, and in most of their range, they are generally solitary or found in small groups. The sperm whale, however, appears to have a defined social heirarchy (Harrison Matthews et al., 1978).

Blue whales, the largest baleen whales, feed almost exclusively on krill (small, shrimp-like zooplankton). There are only two records of blue whales in the Gulf--one in Louisiana in 1924 and another in Texas in 1940. The latter identification is questionable (Schmidly, 1981). No blue whales were sighted in 1980-1981 aerial surveys in the northern Gulf (Fritts et al., 1983). There is no evidence that the blue whale presently or historically frequently occurred in the northern Gulf.

Fin whales, the second largest baleen whales, feed primarily on krill and small schooling fish. There are reports of five strandings and four sightings in the northern Gulf (Schmidly, 1981). Fin whales may occur year-around in the Gulf; however, no fin whales were sighted in aerial surveys during 1980-1981 (Fritts et al., 1983). Darnell et al. (1983) illustrate fin whale habitat as waters at the continental slope and deeper.

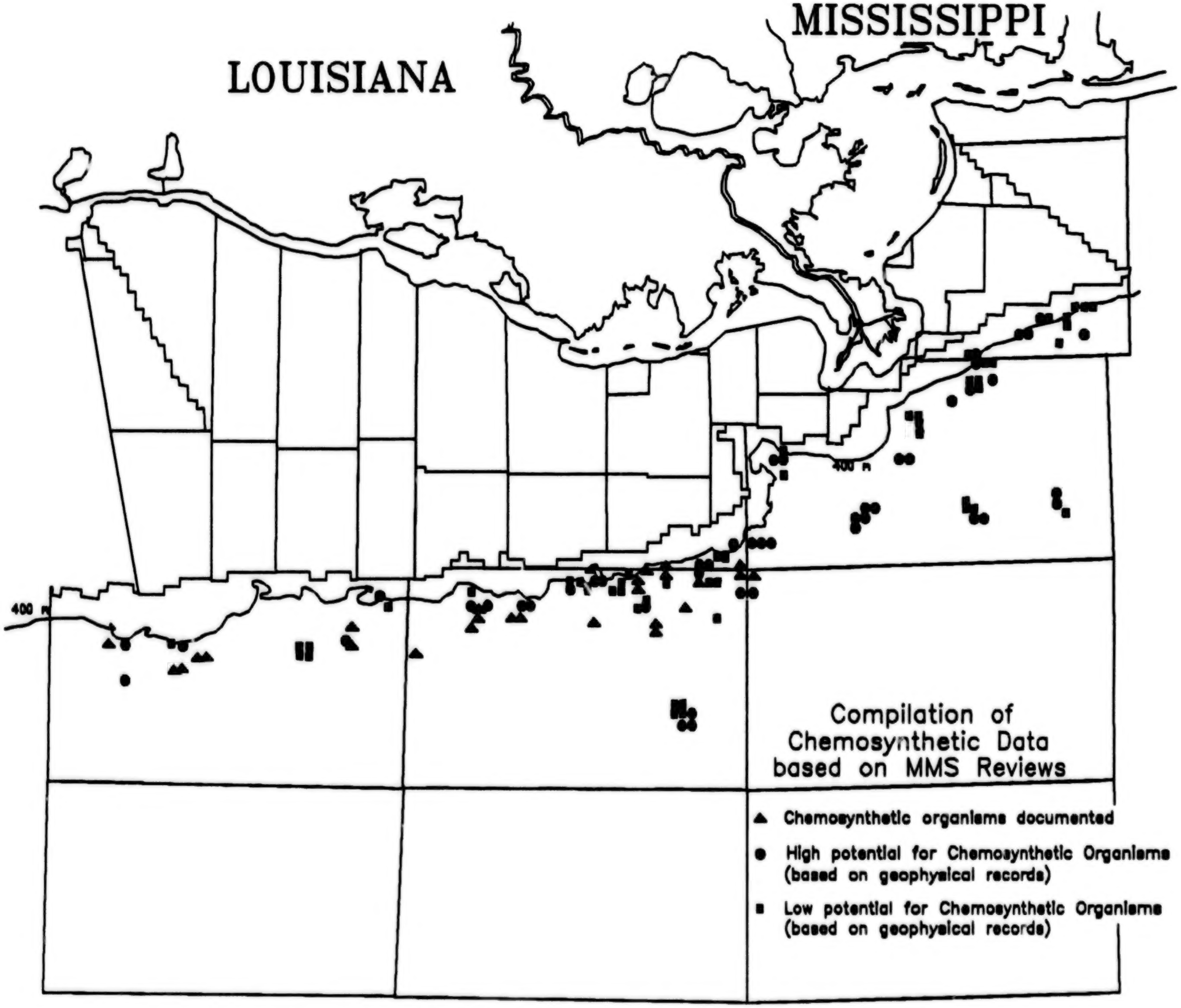

MISSISSIPPI
LOUISIANA
400 ft
400 ft
Compilation of Chemosynthetic Data based on MMS Reviews
▲ Chemosynthetic organisms documented
● High potential for Chemosynthetic Organisms (based on geophysical records)
■ Low potential for Chemosynthetic Organisms (based on geophysical records)

Figure III-4. Compilation of Chemosynthetic Data(Central Gulf of Mexico).

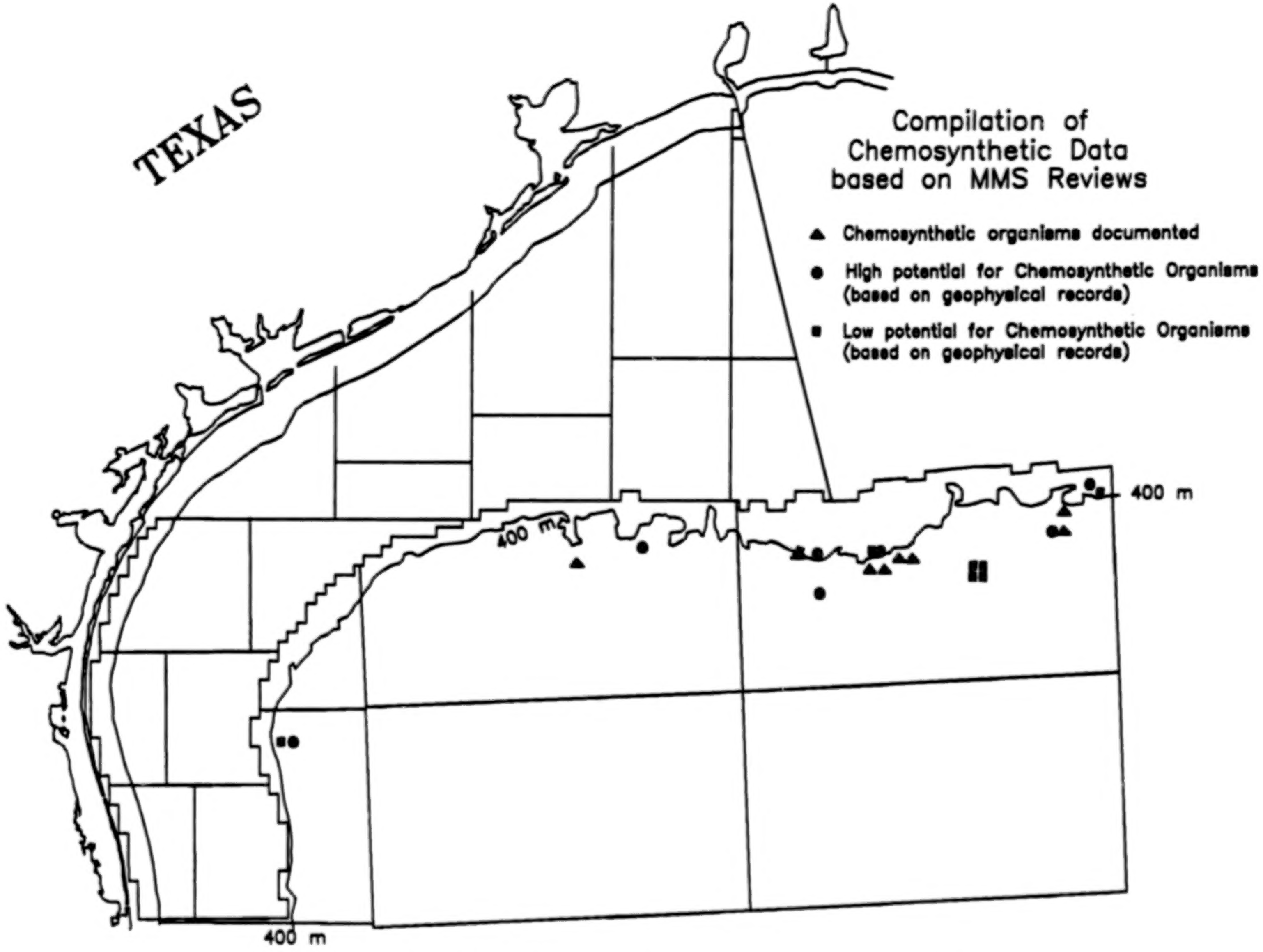

TEXAS
Compilation of Chemosynthetic Data based on MMS Reviews
▲ Chemosynthetic organisms documented
● High potential for Chemosynthetic Organisms (based on geophysical records)
■ Low potential for Chemosynthetic Organisms (based on geophysical records)
400 m
400 m
400 m

Figure III-5. Compilation of Chemosynthetic Data(Western Gulf of Mexico).

Table III-1

Marine Mammals of the Northern Gulf of Mexico

	Central Gulf of Mexico	Western Gulf of Mexico	Habitat and Food Sources
Cetaceans			
1. Right whale (*Eubalaena glacialis*)*	N	R	1. Possible winter resident in Eastern Gulf. Possible winter mating and calving. Feeds on copepods.
2. Blue whale (*Balaenoptera musculus*)*	N	R	2. Rare. Feeds on krill (small shrimp-like crustaceans).
3. Sei whale (*Balaenoptera borealis*)*	R	N	3. Possible year-round resident. Possible winter calving and mating. Feeds on copepods, krill, and small schooling fishes.
4. Fin whale (*Balaenoptera physalus*)*	U	R	4. Possible winter resident. Possible mating and calving in winter. Feeds mostly on krill and small schooling fishes (capelin and herring).
5. Bryde's whale (*Balaenoptera edeni*)	R	N	5. Possible year-round resident. Feeds on small schooling fishes, some krill, and other crustaceans.
6. Minke whale (*Balaenoptera acutorostrata*)	R	N	6. Possible winter resident in Eastern Gulf. Feeds on small shoal fishes (herring, cod, pollack, and capelin).
7. Humpback whale (*Megaptera novaeangliae*)*	N	N	7. Possible winter resident in Eastern Gulf. Feeds on krill, copepods, and small schooling fishes.
8. Sperm whale (*Physeter catodon*)*	C	C	8. Winter resident or possibly year-round. Calving in summer. Feeds on squid, octopus, and some fishes.
9. Pygmy sperm whale (*Kogia breviceps*)	R	C	9. Possible year-round resident. Feeds on squid, fishes, and pelagic crustceans.
10. Dwarf sperm whale (*Kogia simus*)	R	U	10. Uncommon, possible year-round resident. Feeds on squid, fishes, and pelagic crustaceans.
11. Blainville's beaked whale (*Mesoplodon densirostris*)	R	N	11. A deepwater species, possible winter resident. Feeds on squid.
12. Antillean beaked whale (*Mesoplodon europaeus*)	N	R	12. Rare. Feeds on squid.
13. Goosebeaked whale (*Ziphius cavirostris*)	R	R	13. Rare. Feeds on squid and deepwater fishes.
14. Pygmy killer whale (*Feresa attenuata*)	N	R	14. Rare. Feeds on squid and fishes.
15. False killer whale (*Pseudorca crassidens*)	R	R	15. Uncommon, usually found in Eastern Gulf. Feeds on squid and large fishes.
16. Killer whale (*Orcinus orca*)	N	R	16. Uncommon. Feeds on squid, fishes, seabirds, sea turtles, and other marine mammals.

Table III-1. Marine Mammals of the Northern Gulf of Mexico (continued)

	Central Gulf of Mexico	Western Gulf of Mexico	Habitat and Food Sources
17. Short-finned pilot whale (*Globicephala macroryhnchus*)	U	C	17. Year-round in deep water. Feeds on squid and fishes.
18. Rough-toothed dolphin (*Steno bredanensis*)	R	R	18. Rare. Feeds on fishes and squid.
19. Saddleback dolphin (*Delphinus delphis*)	R	R	19. May be year-round near shelf edge. Feeds on squid, fishes, and small schooling fishes.
20. Atlantic bottlenose dolphin (*Tursiops truncatus*)	C	C	20. Common. Year-round out to shelf edge. Feeds mostly on fishes.
21. Grampus (*Grampus griseus*)	N	N	21. Uncommon, usually found in Eastern Gulf. Feeds on fishes and squid.
22. Bridled dolphin (*Stenella frontalis*)	N	R	22. Uncommon. Feeds on fishes and squid.
23. Atlantic spotted dolphin (*Stenella plagiodon*)	C	C	23. Common. Year-round move inshore in the late spring. Feeds primarily on squid, also carangid fishes, eels, and small schooling fishes.
24. Striped dolphin (*Stenella coeruleoalba*)	R	R	24. Uncommon. Feeds on fishes, squid, and crustaceans.
25. Spinner dolphin (*Stenella longirostris*)	N	U	25. May be year-round resident. Feeds on fishes and squid.
26. Short-snouted spinner dolphin (*Stenella clymene*)	N	R	26. A deepwater species which occurs primarily in the Eastern Gulf. Possible winter resident. Feeds on squid, fishes, and shrimp.
Pinnipeds			
27. California sea lion (*Zalophus californianus*)	R	N	27. Usually feral individuals. Breeding probably does not occur in this region. Feeds on squid and small fishes.
Sireheans			
28. West Indian manatee (*Trichechus manatus*)*	R	N	28. Presently not found west of Aucilla and Port St. Joe Rivers, Florida. Feeds primarily on aquatic vegetation.

*Endangered Species 50 CFR 17.11 and 17.12 (April 10, 1987)

N - No strandings or sightings.
R - Rare, 1-3 strandings or sightings.
U - Uncommon, 4-6 strandings or sightings.
C - Common, 7 or more strandings or sightings.

Source: Breiwick and Braham, 1984; Gaskin, 1982; Leatherwood, et al., 1976; Schmidly, 1981; Waring, 1976.

Humpback whales are a coastal species and feed primarily on krill and fish. Humpbacks have been sighted in the Central Gulf (in 1952 and 1957), in the Eastern Gulf near the mouth of Tampa Bay (in 1962 and 1983), and near Seahorse Key, Florida (in 1983) (Schmidly, 1981; Gainesville Sun, 1983). No humpback whales were observed in the northern Gulf during the 1980-1981 aerial surveys (Fritts et al., 1983).

Right whales are the most endangered cetacean in the Gulf of Mexico. The population in the Gulf is unknown; however, only 250-350 right whales are estimated to occur in the northwestern Atlantic Ocean. Right whales are specialized as "skimmers" that feed by swimming slowly with their mouths wide open through concentrations of copepods. They usually feed at or just below the surface. Two right whales have been reported in the northern Gulf from Brazoria County, Texas, in 1972 and from Manatee County, Florida, in 1963 (Lowery, 1974). No right whales were observed in the northern Gulf during the 1980-1981 aerial surveys (Fritts et al., 1983).

Sei whales feed primarily on copepods, krill, and small schooling fish. They usually travel in groups of two to five individuals. Two sei whales have been reported in the northern Gulf from Plaquemines Parish, Louisiana, in 1956 and from Gulfport, Mississippi, in 1973. No sei whales were observed in the northern Gulf during the 1980-1981 aerial surveys (Fritts et al., 1983).

The great sperm whales are probably the most abundant whales in the northern Gulf. They feed mainly on mesoplagic squid and also large demersal and mesoplagic sharks, skates, and fish (Rupp-Fulwiler, 1978). Numerous strandings and sightings of sperm whales have been reported in the Gulf for every month. These whales usually inhabit offshore waters and are usually not found in waters less than 3,300 ft (1,000 m) (Watkins, 1977). During the 1980-1981 aerial surveys, sperm whales were observed on 13 occasions in the northern Gulf (Fritts et al., 1983).

The FWS has designated 15 threatened or endangered species that could be affected by OCS oil and gas operations in the Gulf. All but the American crocodile inhabit the Central and Western Gulf. The list includes three mammals (the jaguarundi, ocelot, and West Indian manatee), seven birds (the bald eagle, arctic peregrine, whooping crane, brown pelican, eskimo curlew, piping plover, and least tern), and six reptiles (the American crocodile and the hawksbill, Kemp's ridley, loggerhead, leatherback, and green sea turtles).

The green turtle is listed as endangered in Florida waters and threatened throughout the rest of the Gulf of Mexico. It usually frequents shallow reefs, shoals, lagoons, and bays where marine grasses and algae are plentiful. Its preferred nesting sites are steep, sloped beaches, well above high tide, in the Yucatan Peninsula, Caribbean, and Florida.

The Kemp's ridley turtle inhabits shallow coastal and estuarine waters. Ridley turtles commonly occur in shallow water areas from Marsh Island to the Mississippi Delta in Louisiana (Hildebrand, 1982) and from Bolivar Roads to Sabine Pass in Texas. Kemp's ridley turtles infrequently nest on the beaches of southwestern Padre Island, Texas, where FWS, NMFS, and NPS have established a ridley turtle head-start release program. It feeds on crabs, fish, jellyfish, barnacles, and mollusks throughout the Gulf Coast. Coastal Louisiana appears to be an important subadult and feeding habitat (Hildebrand, 1982).

The hawksbill turtle inhabits reefs, shallow coastal areas, and passes in water less than 15 m deep, where they feed on benthic invertebrates and vegetation (Fuller et al., 1987). The hawksbill is a solitary nester between latitudes 25 degrees north and 25 degrees south and along the Gulf Coast of Florida.

The leatherback turtle is the most pelagic marine turtle and may be found near the continental shelf edge. Sightings have been reported along the Gulf Coast in March and April; no recent nesting has been reported along the Gulf Coast.

The loggerhead turtle occurs throughout the Gulf and has been observed as far as 500 miles offshore. It frequents natural and manmade structures, including oil and gas platforms where they forage on benthic invertebrates, fish, and aquatic vegetation. Nesting in the Gulf occurs primarily in Florida, from the Keys to Tampa Bay and occasionally in Texas and Louisiana.

Brown pelicans have been removed from the Federal endangered species list in Alabama and Florida but remain listed as endangered in Mississippi, Louisiana, and Texas. About 165 brown pelicans inhabit Gaillard Island in Mobile Bay near Theodore, Alabama. Three brown pelican rookeries (totaling approximately 2,100 nests) occur on Last Island (Terrebonne Parish), North Island (St. Bernard Parish), and Queen Bess Island (Jefferson Parish), Louisiana. Also, a small population (about 300 nesting pairs) of brown pelicans occurs on Pelican Island in Nueces County, Texas, and another is being reestablished in the Brazoria National Wildlife Refuge in Brazoria County, Texas. The habitat of these colonial nesters is small coastal inlands in salt and brackish water areas as indicated on Visual No. 2.

Endangered bald eagles inhabit all the central and western Gulf coastal areas except in Alabama. They are primarily riparian and opportunistic feeders, which make them susceptible to the health hazards of consuming fish killed by oil spills. The endangered Mississippi sandhill cranes inhabit a portion of savanna and piney flat woods near the Gulf Coast in Jackson County, Mississippi. Their limited range and small population makes them susceptible to shore-based OCS development. Approximately 80-90 endangered whooping cranes overwinter in the marshes, tidal flats, and barrier islands of the Aransas National Wildlife Refuge (NWR) near Aransas, Texas, and surrounding wetland areas from October through April. The OCS oil and gas operations could adversely affect the whooping crane by disturbance of habitat or reproductive success from contact with oil or shore-based disturbance.

Four species of endangered birds--the piping plover, eskimo curlew, arctic peregrine, and least tern--migrate through or winter in the Central and Western Gulf. The piping plover utilizes the beaches, sandflats, and dunes of Texas and Louisiana between September and March. The arctic peregrine occurs throughout the Gulf Coast during their fall and spring migration between the Arctic and South America. Occasionally, a few will winter along the Texas coast or migrants will "stage" in April and October on North and South Padre Islands. The eskimo curlew has rarely been sighted in recent history. Their historic spring migration between South America and the Arctic routed them north along the Mississippi River and Texas coast.

Two endangered felines--the jaguarundi and the ocelot--inhabit the lower Rio Grande Valley and coastal areas in and around the Santa Ana and Laguna Atacosa National Wildlife Refuges. The FWS is concerned that land clearing to develop shore bases for OCS operations will reduce the habitat of the jaguarundi and ocelot.

Manatees occur infrequently in the Central and Western Gulf of Mexico due to the species physiological requirements for warm water. The northern Gulf appears to be climatically unsuitable to the manatee and has acted as a geographic barrier to the interaction of the Antillean and West Indian populations. Eleven manatees have been sighted in the Central and Western Gulf since 1975. In two of the sightings, the animals were found dead of anorexia and cold stress. The two sightings in Texas are thought to be of the Antillean population coming from Mexico. The others, seven in Louisiana and two in Mississippi, are thought to be from the West Indian population originating in Florida (Beeler and O'Shea, 1988). Additional information on endangered and threatened species is found in the FWS and NMFS biological opinions in Appendix B and on Visual No. 2.

4. Marine Mammals

All 20 species of nonendangered marine mammals (Table III-1) that occur in the northern Gulf region (Schmidly, 1981) are protected under the Marine Mammal Protection Act of 1972 (Section I.B.4.f.). About eight of these species were observed by aerial surveys of the northern Gulf during 1980-1981 (Fritts et al., 1983). The survey indicated that the bottlenose dolphin was the most common nonendangered marine mammal sighted, followed in order of abundance by the striped, spotted, and spinner dolphins; short-finned pilot whale; pygmy killer whale; grampus; and beaked whale (*Mesoplodon* species) (Fritts et al., 1983). All have ubiquitous distribution in the northern Gulf.

Studies indicate that bottlenose dolphins are particularly abundant near ship channels and seasonally near natural channels or "passes" into the northern Gulf (Gruber, 1981; Irvine et al., 1981). The majority of bottlenose dolphin sightings occurred at depths less than 50 m (164 ft); water depth apparently has a more important influence on distribution than does distance from shore (Fritts et al., 1983). Aerial surveys of the Louisiana-Mississippi coastal waters indicate about 2,000-6,000 bottlenose dolphins (Leatherwood and Platter, 1975). Aerial surveys offshore Marsh Island, Louisiana, indicate about 1 dolphin/1.4 mi^2 (1 dolphin/3.7 km^2) (Fritts et al., 1983). Surveys offshore Texas reported about 1,000-5,000 dolphins (Orr, 1977). Aerial surveys indicate about 1 dolphin/1.9 mi^2 (0.203 dolphins/4.9 km^2) offshore Brownsville, Texas (Fritts et al., 1983). Dolphins usually occur in herds of 3-7 animals, but large herds of 200-600 dolphins have been observed. Herd size may vary substantially according to depth and complexity of habitat, with larger herds usually in more open-water habitats (Wells et al., 1980). At least in some portions of the bottlenose dolphins range, populations form relatively permanent social units that are closely tied to definable home ranges (Shane et al., 1986).

Bottlenose dolphins are occasionally hit by boats, drowned in nets, shot, or harpooned (Leatherwood and Reeves, 1982). The lack of bottlenose dolphins in some areas may be directly or indirectly related to pollution (FAO-ACMRR, [illegible]) There is little evidence of deleterious effects of oil pollution on bottlenose dolphins. Geraci and St. Aubin (19[illegible]) concluded that contact with oil may have no significant long-term effects on cetaceans.

5. Birds Associated with the Coastal Area

The initial and most conspicuous casualities of OCS-related oil spills are externally oiled seabirds that may drift onto shore. Those birds most susceptible to oiling either raft at sea, usually in large numbers, such as gulls and terns, or dive when disturbed, such as cormorants and boobies. Because of the strong visual impact, the death of birds associated with the coastal area from OCS-related oil/gas activities receives an inordinate amount of publicity (Clapp et al., 1982a; NAS, 1985).

The beaches and wetlands of the northern Gulf of Mexico are populated by both migrant and nonmigrant species of coastal and marine birds. This broad category consists of three main groups: shorebirds, wading birds, and waterfowl. Feeding habitats include waters of the open Gulf and estuaries, as well as coastal farm lands and landfills. Reproductive activity occurs from February through August (Clapp et al., 1982a and b). Portnoy (1977) recorded 847 thousand birds, representing 26 species, in habitats ranging from swamp forest to coastal marshes and barrier islands in the Central Gulf area.

Waterfowl consist mainly of ducks and geese. The majority of waterfowl found in the northern Gulf of Mexico coastal wetlands are overwintering migrants. The peak of the fall migration is November-December. Spring migration can begin as early as March and last through May. The major waterfowl habitats are brackish and freshwater marshes. These habitats are capable of supporting 4-7 million migratory waterfowl per season (Bellrose, 1976). The national wildlife refuges and State wildlife management areas provide important feeding and resting areas for migratory waterfowl. A few species of waterfowl are residents of the Gulf coastal area. They inhabit swamp forests and marshes in all Central and Western Gulf states (Portnoy, 1977; Clapp et al., 1982a and b).

Wading birds consist mainly of heron, egrets, cranes, ibis, and storks. Although their range extends to barrier islands, very few wading birds are seen offshore in the Gulf. The most abundant species are tricolor herons, snowy egrets, and cattle egrets (Fritts et al., 1983).

Shorebirds are closely associated with marine environments and consist mainly of gulls, terns, boobies, petrels, and shearwaters. With the exception of gulls, marine birds feed and roost offshore, coming ashore for nesting or when storms blow them inshore. The largest concentrations of marine birds are found near locations of high productivity; i.e., upwelling areas near the continental slope edge. Aerial surveys off Marsh Island, Louisiana, and Brownsville, Texas, have determined that out of 25 and 24 species, respectively, greater than 90% of the marine birds were gulls and terns. Terns feed almost exclusively offshore while gulls utilize coastal farmlands and landfills as well (Clapp et al., 1982a and b).

6. Fish Resources

Commercial and recreational fisheries in the Gulf of Mexico are dominated by estuary-dependent species. The life history of estuary-dependent species involves spawning on the continental shelf; transport of eggs, larvae, or juveniles to the estuarine nursery grounds; growth and maturation in the estuary; and migration of the young adults back to the shelf for spawning. After spawning, the adult individuals generally remain on the continental shelf. Most estuary-related species of importance--menhaden and shrimp--have short life histories of 18-36 months, but some sciaenids--croaker, and red and black drum--may live for several years (Darnell, 1988). Section II of Final EIS 113/115/116 (USDI, MMS, 1987b) describes life histories of economically important species in the Gulf.

Finfish and shellfish are sensitive to oil in varying degrees during all their life stages (Anderson, 1985). Table III-6 of Final EIS 113/115/116 (USDI, MMS, 1987b) details geographical distribution of life stages for the two most important commercial species in the Gulf of Mexico--menhaden and shrimp. Although they are both considered continental shelf species, they are estuary dependent. This means that spawning times and places must be synchronized with hydrography such that eggs, larvae, and young arrive at estuary nursery areas during the appropriate season. Menhaden spawn near the water surface in a localized area of the middle continental shelf proximate to the Mississippi River Delta during the winter and early spring. During late spring young menhaden enter the nursery areas from the delta region to as far west as Galveston Bay. The two major shrimp species--brown and white--spawn in a widely distributed area of the middle continental shelf during non-overlapping short periods in spring and summer. Their larvae become dispersed throughout the water column and along a broad east-west band on the inner shelf before tides, currents, and wind bring the postlarvae into estuary nursery areas in early spring. In this manner, brown and white shrimp utilize extensive nursery areas from the west coast of Florida to the east coast of Mexico.

Darnell et al. (1983) and Darnell and Kleypas (1987) found that the density distribution of total fish and penaeid shrimp catch in the northwestern Gulf was highest nearshore off Louisiana (see back of Visual No. 2, Total Fish Catch [numerical abundance], Summer). For all seasons the greatest abundance of fish and penaeids occurred between Galveston Bay and the Mississippi River. This may be directly attributable to the extensive estuary nursery areas of Louisiana. In addition, these estuaries are also known to export considerable quantities of organic material, thereby enriching the adjacent continental shelf areas (Darnell and Soniat, 1979).

Approximately 30% of the other numerically significant fish species from the continental shelf are also estuary dependent. Low salinity estuaries are dominated by oysters, crabs, sciaenids, anchovies, and mullets. Populations from the inshore shelf zone (7-14 m) are dominated seasonally by Atlantic croaker, spot, drum, silver seatrout, southern kingfish, and Atlantic threadfin. Populations from the middle shelf zone (27-46 m) include sciaenids, but are dominated by longspine porgies. The blackfin searobin, Mexican searobin, and shoal flounder are dominant on the outer shelf zone (64-110 m). Natural reefs and banks, located mainly between the middle and outer shelf zones, and the numerous offshore platforms acting as artificial reefs, support such fishes as snappers, groupers, mackerels, and seabass. Oceanic fish such as tuna and swordfish inhabit deep ocean waters south of the Central and Western Gulf area.

A total of nine species of penaeid shrimp contribute to the Gulf of Mexico commercial shrimp fishery. Brown, white, pink, royal red, and rock shrimp constitute the bulk of the harvest. Brown shrimp are centered in the northwestern Gulf. White shrimp are centered on the mud and sand bottoms in the Central Gulf. Royal red shrimp are located in the deep waters of the Mississippi and DeSoto Canyons. Pink shrimp have an almost continuous distribution throughout the Gulf, but consistent commercial pink and rock shrimp catches are made on the shell, coral sand, and coral silt bottoms off southern Florida. See Visuals Nos. 2 and 2E for major finfish and shellfish harvesting areas.

Gulf menhaden occur in the inshore waters of the northcentral Gulf from eastern Florida to eastern Texas with approximately 93% of the harvest occurring within 10 miles of shore. The industrial bottom fishery also occurs in the nearshore waters of the northcentral Gulf taking advantage of the seemingly inexhaustible numbers of sciaenids. Atlantic croaker constitutes the largest component of the catch, which includes spot, sand seatrout, silver seatrout, cutlass fish, sea catfish, and longspine porgy.

Recent data analysis indicates a major change in characteristics of the finfishery during the interval from 1981 through 1987. The number of commercial species landed increased significantly from 27 in 1981 to 82 in 1987. In addition, the number of species with a value over $1 million has tripled from 3 in 1981 to 9 in 1987 (Linton, 1988). Some of the more valuable species include snappers, groupers, mackerel, red and black drum, spotted and silver seatrout, pompano, crevalles, and sheepshead. The vast majority of this catch is harvested from the northcentral and northwestern Gulf, where hard substrate added by numerous offshore petroleum platforms is thought to be a positive contributing factor (Linton, 1988).

Virtually all the important species in Alabama, whether shellfish or finfish, are estuary dependent. Alabama's dominant commercial catches are shellfish (shrimp, crab, and oyster). The oyster fishery is supported by 3,064 acres of public reefs located mainly in the southern half of Mobile Bay. Shrimping is the most significant fishery in Alabama with a commercial fleet of approximately 2,300 registered vessels (Alabama Coastal Area Board, 1980). Brown, white, and pink shrimp are the predominant species caught, with brown and white contributing the most to the harvest. The important commercial food finfish include Atlantic sheepshead, flounder, black drum, seatrout, and black mullet. Commercial fish landings in Alabama during 1987 were 17 million pounds valued at $27 million (USDC, NMFS, 1988a).

The high productivity of the Mississippi Sound estuarine system, about 433,000 acres, produces large quantities of finfish and shellfish harvested by Mississippi. This system includes all coastal waters of Mississippi and is bounded on the west by Lake Borgne, on the east by Mobile Bay, on the south by the Mississippi barrier islands, and on the north by the extent of tidal influence into the riverine region (Mississippi Bureau of Marine Resources, 1981). Approximately 5,000 acres of State-managed public oyster beds are located throughout the Sound. Brown, white, and pink shrimp are the predominant shrimp species caught. Brown and white shrimp contribute the most to the harvest and are the most important harvest in Mississippi in terms of both quantity and value. Menhaden is the most valuable finfish landed while Atlantic croaker, spot, and sand seatrout are harvested by the industrial bottomfish fishery. Bottomfish are harvested from waters of the middle shelf and support a coastal pet food industry. The important commercial food finfish include black drum, red drum, and flounder. Commercial fish landings in Mississippi during 1987 were 437 million pounds valued at $48 million (USDC, NMFS, 1988a).

Approximately 1,532,000 acres of estuaries play a dominant role in the production of commercial fisheries in the coastal areas of Texas (Diener, 1975). Shrimp, oysters, blue crabs, and numerous finfish constitute the principal fisheries. In recent years, shrimp (brown and white) have consistently accounted for 75% of the landings and 95% of the landings value for Texas (Restrepo and Associates, 1982). Hofstetter and Ray (1988) reports that nearly 80% of the oyster production in Texas comes from the Galveston Bay system. However, over the past decade Texas oyster grounds have been impacted by conditions of hypersalinity and the harvest of oysters has been limited by contamination from fecal coliforms (Hofstetter and Ray, 1988). The important commercial food finfish include red snapper, spotted seatrout, black drum, cobia, pompano, sheepshead, and flounder. Commercial fish landings in Texas during 1987 were 111 million pounds valued at $200 million (USDC, NMFS, 1988a).

Louisiana is the most productive state in the Gulf of Mexico in terms of commercial fisheries because of its extensive estuaries, coastal marshes, and nutrient input from the Mississippi and Atchafalaya Rivers. Coastal Louisiana contains approximately 60% of the estuaries and marshes in the Gulf of Mexico. Over 90% of the blue crab harvest, which amounts to about 50 million pounds, comes from estuary nursery areas. Shrimp constitutes the most valuable fishery with highly variable landings that depend on environmental conditions in the estuaries during postlarval development. Commercial production is generally good with an early and relatively dry spring (Barrett and Ralph, 1976). Menhaden constitutes the greatest amount landed in Louisiana and is supported by an extensive nearshore fleet and three ports that specialize in the landing of menhaden. Nearly 20,000 acres of oyster reefs are managed by the State as oyster seed ground reservations. There are about 234,000 acres of private oyster leases in Louisiana and 690,000 acres of public oyster grounds. However, over the past 50 years, Louisiana oyster grounds have been increasingly impacted by the loss of wetlands and subsequent saltwater intrusion. More recently, the harvest of oysters has been limited by contamination from fecal coliforms (Dugas, 1988). The important commercial food finfish include red snapper, spotted seatrout, black drum, Atlantic sheepshead, flounder, red drum, and swordfish. Commercial fish landings in Louisiana during 1987 were 1.8 billion pounds valued at $316 million (USDC, NMFS, 1988a).

C. SOCIOECONOMIC CONDITIONS

The socioeconomic impact area comprises 49 counties and parishes. The coastal counties/parishes extend from Baldwin County in Alabama to Cameron County in southernmost Texas. Inland counties/parishes are included where offshore oil and gas support activities are known to exist (such as Lafayette, Louisiana); where offshore-related petroleum industries are established (such as the Mississippi River region in Louisiana); and to account for all counties within the Standard Metropolitan Statistical Areas (SMSA) boundaries when one county is on the coast. The counties/parishes in this socioeconomic impact area are:

Central Gulf of Mexico
- Alabama - Baldwin, Mobile
- Mississippi - Hancock, Harrison, Jackson, Stone
- Louisiana - Ascension, Calcasieu, Cameron, East Baton Rouge, Iberia, Jefferson, Lafayette, Lafourche, Livingston, Orleans, Plaquemines, St. Bernard, St. Charles, St. James, St. John the Baptist, St. Mary, St. Tammany, Terrebonne, Vermilion, West Baton Rouge

Western Gulf of Mexico
- Texas - Aransas, Brazoria, Calhoun, Cameron, Chambers, Fort Bend, Galveston, Hardin, Harris, Jackson, Jefferson, Kenedy, Kleberg, Liberty, Matagorda, Montgomery, Nueces, Orange, Refugio, San Patricio, Victoria, Waller, Willacy

The Gulf region is comprised of counties/parishes in the Eastern, Central, and Western Gulf of Mexico, including those counties on the west coast of Florida assumed to be impacted by the OCS leasing program. However, for purposes of this discussion, the socioeconomic impact area will consist only of those counties/parishes in the Central and Western Gulf of Mexico because the proposed lease sales for 1990 involve the offering of the Central and Western Planning Areas. The two zones of the Gulf Region vary substantially in socioeconomic patterns ranging from low-density, undeveloped rural areas to high-density, highly developed urban centers. There are 12 SMSA's in the region (in east to west order):

Central Gulf of Mexico
Alabama - Mobile
Mississippi - Pascagoula, Biloxi-Gulfport
Louisiana - New Orleans, Baton Rouge, Lafayette, Lake Charles

Western Gulf of Mexico
Texas - Beaumont-Port Arthur, Houston-Galveston-Brazoria, Victoria, Corpus Christi, Brownsville-Harlingen

The most populated SMSA's across the two zones in the region are New Orleans and Houston-Galveston-Brazoria. The least populated are Pascagoula and Victoria.

The highest levels of employment by major industry groups in each state's coastal region are in the areas of manufacturing, wholesale/retail trade, and services (including finance, insurance, and real estate (F.I.R.E.)). A summary of specific employment, income, and population characteristics is given below.

1. Employment

Table III-2 reflects the historic indicators for the labor force and unemployment in the Gulf region. In 1970, the regional unemployment rate (4.0%) was just below that of the United States (4.4%); in 1980, the regional rate (5.6%) was well below the comparable United States figure (7.1%); and in 1988, the regional rate (7.2%) was well above that of the United States (5.8%).

Table III-2

Labor Force Data
(Gulf of Mexico Region*)

	Labor Force (000)			Unemployment Rate (%)		
	1970	1980	1988**	1970	1980	1988**
Florida	1,076.4	1,929.7	2,863.8	3.7	5.8	4.8
Alabama	133.8	183.1	207.3	5.3	7.5	9.0
Mississippi	78.9	108.1	148.4	4.3	7.7	8.1
Louisiana	742.6	1,081.3	1183.7	4.9	5.9	10.4
Texas	1,235.3	2,032.7	1,993.3	3.5	5.0	8.4
Gulf Region	3,267.0	5,334.9	3,532.8	4.0	5.6	7.2
United States	82,700.0	106,821.0	120,136.0	4.4	7.1	5.8

*Data shown for each state are for those counties/parishes in the socioeconomic impact area.
**Data used are a 7-month average for 1988 due to unavailability of data for the remainder of the year.

Sources: Alabama Department of Industrial Relations, Research, and Statistics, 1988.
Labor Force Estimates for Texas Counties, 1980 and 1988.
Labor Market Information, 1980 and 1988.
Labor Market Trends, 1980 and 1988.

Labor force data for the three central Gulf states is given in Table III-2. In both 1970 and 1980, all three states' coastal areas had unemployment rates above the regional average. In 1970, the Louisiana and Alabama coastal regions' unemployment rates were above the United States rate; while in 1980, the Mississippi and Alabama regions were above the United States rate. In 1988, the unemployment rates for Mississippi (8.1%) and Alabama (9.0%) and Louisiana (10.4%) were above that of the Gulf region (7.2%) and that of the United States (5.8%).

Employment by major industry group for Alabama is shown in Table III-3. In 1985, the highest levels of employment for the coastal region were recorded in the sectors of wholesale and retail trade (31.93%), services (31.80%), and manufacturing (17.52%); while the highest levels of employment for the State as a whole were recorded in the sectors of manufacturing (28.97%), wholesale and retail trade (25.79%), and services (25.74%). Mobile County accounts for the majority of all employment in the Mobile SMSA. Between 1970 and 1985, wholesale and retail trade has continued to increase in relative share of the labor force in the Alabama coastal area.

Table III-3 also provides employment by major industry group in Mississippi. The levels of employment for the coastal region were recorded in the sectors of manufacturing (29.01%), wholesale and retail trade (26.78%), and services (23.52%); while the levels for the State as a whole were recorded in the sectors of manufacturing (32.47%), wholesale and retail trade (26.83%), and services (23.92%). Manufacturing remains concentrated primarily in Jackson County (Pascagoula SMSA), while trade and services were concentrated in Harrison County (Biloxi-Gulfport SMSA).

Employment by major industry group for the Louisiana coastal region is also shown in Table III-3. Leading sectors in the coastal parishes were services (32.44%), wholesale and retail trade (29.62%), and manufacturing (11.36%). Leading levels of employment for the State as a whole were recorded in the sectors of services (31.15%), wholesale and retail trade (29.62%), and manufacturing (13.78%). As in the past, manufacturing in the State and the coastal parishes is still far lower in relative share of the labor market than in the other coastal regions. Employment in the leading sectors was concentrated in Orleans and Jefferson Parishes of the New Orleans SMSA and in East Baton Rouge Parish of the East Baton Rouge SMSA.

Labor force data for the Texas coastal area is shown in Table III-2. In both 1970 and 1980, the unemployment rate for this coastal zone was below that of the aggregate Gulf region and United States rates. In 1988, the Texas unemployment rate (8.4%) was above that of the region (7.2%) and well above that of the United States (5.8%).

Table III-4 gives the breakdown of employment by major industry groups for Texas. Leading levels of employment in the coastal areas were in the sectors of services (31.60%), wholesale and retail trade (28.14%), and manufacturing (15.64%). Leading levels of employment in the State as a whole were also in the sectors of services (30.81%), wholesale and retail trade (29.16%), and manufacturing (17.52%). Manufacturing in both the coastal area and the State decreased slightly from 1984 to 1985. In 1985, employment in the coastal areas was highly concentrated in Harris County (Houston-Galveston-Brazoria SMSA) and in Jefferson and Nueces Counties (Beaumont-Port Arthur and Corpus Christi SMSA's, respectively).

2. Income and Payroll

Total and per capita personal income for the Gulf region are shown in Table III-5. The per capita personal income for the region ($3,600) was 92% of the United States level ($3,900) in 1970. In 1978, the Gulf region and United States figures were equal ($7,900). In 1986, which is the latest year for which this type of information is available on a countywide basis, per capita personal income for the Gulf region ($13,600) was below the United States level ($14,600).

Alabama and Mississippi historically have low personal income indicators. In 1970, the per capita income of these states was 83% and 89% ($3,000 and $3,200) of the Gulf region value ($3,600) and 77% and 82% of the national level ($3,900), respectively. In 1978, Alabama's per capita income had risen above that of Mississippi's, yet both states had dropped to 80% and 77% ($6,300 and $6,100) of both the Gulf region ($7,900) and United States per capita income levels ($7,900), respectively.

The per capita income of Alabama in 1986 was 82% ($11,100) of the Gulf region ($13,600) and 76% of the United States figure ($14,600); while the per capita income of Mississippi in 1986 ($10,300) was 76% of the Gulf region and 71% of the United States figure. In 1970, the per capita personal income of Louisiana ($3,300) was 92% of that for the Gulf region ($3,600) and 85% of that for the United States ($3,900). In 1978, the per capita personal income for Louisiana ($7,500) was 94% of that for the Gulf region and the United States. In 1986, the figure for Louisiana ($12,300) was 90% of the region's figure and 84% of that for the United States.

Table III-3

Employment by Major Industry Group*
Central Gulf of Mexico - 1985 Percent of Total

	Alabama		Mississippi		Louisiana	
	Coastal Area	State	Coastal Area	State	Coastal Area	State
Agriculture, Forestry, Fishing	0.48	0.41	0.24	0.54	0.34	0.42
Mining**	0.63	1.19	0.64	1.32	6.83	6.32
Contract Construction	8.54	6.49	4.21	5.50	7.65	7.64
Manufacturing	17.52	28.97	29.01	32.47	11.36	13.78
Transportation, Communications, Utilities	7.04	5.84	5.48	5.30	9.48	8.38
Wholesale, Retail Trade	31.93	25.79	26.78	26.83	29.62	29.62
Services, including F.I.R.E.	31.80	25.74	23.52	23.92	32.44	31.15
Government	2.06	5.57	10.13	4.13	2.29	2.68

*Totals of industry percentages may not equal 100 due to rounding.

**With the exception of mining, coastal area totals do not include data reported as statewide. For mining, a percentage of the data reported as statewide is included in the total (Alabama, 40%; Mississippi, 15%; and Louisiana, 65%). These percentages are based on an MMS analysis of County Business Patterns data and Census of Mineral Industries data.

Sources: USDC, Bureau of the Census, 1985.
USDC, Bureau of the Census, 1987.

Table III-4

Employment by Major Industry Group*
Western Gulf of Mexico - 1985 Percent of Total

	Texas Coastal Area	State (Texas)
Agriculture, Forestry, Fishing	0.54	0.51
Mining**	6.35	4.31
Contract Construction	8.45	8.20
Manufacturing	15.64	17.52
Transportation, Communications, Utilities	7.37	6.30
Wholesale, Retail Trade	28.14	29.16
Services, including F.I.R.E.	31.60	30.81
Government	1.91	3.19

*Totals of industry percentages may not equal 100 due to rounding.

**With the exception of mining, coastal area totals do not include data reported as statewide. For mining, 40% of data reported as statewide is included in the total. This percentage is based on an MMS analysis of County Business Patterns data and Census of Minerals Industries data.

Source: USDC, Bureau of the Census, 1985
USDC, Bureau of the Census, 1987.

Table III-5

Income Data of Coastal Counties
in the Gulf of Mexico Region

Per Capita Personal Income
(thousand $)

Area	1970	1978	1986	%Change 1978-1986
Florida	3.5	7.6	14.4	89.5
Alabama	3.0	6.3	11.1	76.8
Mississippi	3.2	6.1	10.3	68.5
Louisiana	3.3	7.5	12.3	63.5
Texas	3.9	8.7	14.0	60.5
Gulf Region	3.6	7.9	13.6	73.3
United States	3.9	7.9	14.6	85.3

Sources: USDC, Bureau of Economic Analysis, 1977; 1980.
USDC, Bureau of Economic Analysis, 1988.

In 1985, the average annual payroll per employee in Alabama ($15,915) was 88% of the Gulf region's ($18,064). In Mississippi, the average payroll ($14,955) was 83% of the Gulf region's; while that of Louisiana ($17,669) was 98% of the Gulf region's.

Texas' Gulf region achieved the largest per capita personal income in the two zones of the coastal region. In 1986, the Texas coastal zone per capita income level ($14,000) was approximately 3% above that of the Gulf region and 96% that of the United States. In 1970 and 1978, the Texas coastal region equalled or surpassed the United States per capita income level. In addition, in 1985, Texas had the highest average annual payroll ($20,541), which was about 14% higher than that for the Gulf region.

3. Population

Table III-6 shows the population changes in the Gulf region for 1970, 1980, and 1986, when growth over this period was substantial. In Alabama the average annual growth rate (1.5%) was slightly less than half that of the Gulf region (3.2%), as was the rate for Louisiana (1.5%), while Mississippi's growth rate (2.4%) was 75% of that of the coastal region. In Texas there is a 3.6% average annual growth rate, which is higher than that for the two zones of the Gulf region. All coastal areas experienced growth rates higher than those for the United States as a whole (1.2%).

4. Coastal Management Programs

The Gulf of Mexico OCS Region is made up of five coastal States. Four of the five States have Federally approved coastal management programs (CMP). The four States are Florida, Alabama, Mississippi, and Louisiana. The fifth State, Texas, conducts coastal management affairs independent of the Federally sponsored coastal zone management planning program.

Regional planning units, made up of a number of cities and counties/parishes, exist in each State. These planning organizations generally conform to State CMP policies and expand these policies into plans and implementation recommendations. A State-by-State description of CMP policies of the Central and Western Gulf of Mexico and the number of the regional planning units in each State follow:

Alabama Coastal Area Management Program (ACAMP)

The Alabama Coastal Area Act (ACAA) of 1976, as amended in 1982 by the Alabama Environmental Management Act (AEMA), divides implementation of coastal resource management between two State agencies: the Department of Environmental Management (DEM) and the Department of Economic and Community Affairs (DECA). Its purpose is to "promote, improve, and safeguard the lands and waters located in the coastal areas of the State through a comprehensive and cooperative program designed to preserve, enhance, and develop such valuable resources for the present and future well being and general welfare for the citizens of this State." Policies are concerned with coastal land and water resource conservation, harbor facilities, and intergovernmental coordination and cooperation. The ACAA and the AEMA provides statutory authority to DEM to review all uses that have a direct and significant effect on the coastal area and require a State permit. DEM's permitting authority must be consistent with approved State policies, rules, and regulations. All coastal area program planning policy formulation, coordination, and resource research and study are performed by DECA. Both permitting and planning functions were formerly conducted by the Coastal Area Board until legislative amendments dissolved the Board and reassigned responsibilities in 1982. The South Alabama Regional Planning Commission serves local governments in the coastal area in an advisory capacity. It has no direct management role in coastal zone matters.

Mississippi Coastal Program

The Mississippi Coastal Program (MCP) is administered by the Mississippi Commission on Wildlife Conservation through the Bureau of Marine Resources (BMR). The primary coastal management statute is the Coastal Wildlife Protection Law (Mississippi Code, Section 49-27-1). The authorities of certain other agencies are incorporated into the MCP pursuant to the Mississippi Code (Section 57-16-6), which requires the coastal program to incorporate "all of coastal Mississippi." BMR, the Bureau of Pollution Control, the Bureau of Land and Water

Table III-6

Population Data of Coastal Counties in the Gulf of Mexico Region (thousands)

Area	1970	1980	1986	% Change 1970-1986	Average Annual Growth Rate 1970-1986
Florida	3,423.3	4,809.1	5,643.2	64.8	4.1
Alabama	376.7	443.5	470.0	24.8	1.5
Mississippi	248.0	309.9	342.6	38.1	2.4
Louisiana	2,141.9	2,477.9	2,659.9	24.2	1.5
Texas	3,104.4	4,286.5	4,882.1	57.3	3.6
Gulf Region	9,294.3	12,326.9	13,997.8	50.6	3.2
United States	203,312.0	226,504.8	241,040.3	18.6	1.2

*Derived from total personal income and per capita income data.

Sources: Environmental Consultants, Inc., 1974.
USDC, Bureau of the Census, 1982.
USDC, Bureau of Economic Analysis, 1988.

Resources, and the Department of Archives and History are identified collectively as the "coastal program agencies." The Mississippi Commission on Wildlife Conservation, acting through BMR, consolidates authorities previously assigned to the Marine Resources Council and the Marine Conservation Commission, including authority to study and develop plans, proposals, reports, and recommendations for the development and use of the coastal and offshore lands, waters, and marine resources of the State. Additional statutory authorities supporting MCP are listed in Table III-11 of Final EIS 94/98/102.

The scope of the Mississippi Coastal Program is built around 10 stated goals. The description of the 10 goals along with the State agency having lead responsibility are hereby incorporated by reference from Table III-12 of Final EIS 94/98/102 (page 133). Presented below is a summary of that material. The program goals are concerned with achieving industrial expansion, preserving coastal wetlands, improving aquatic life, conserving air and water, preserving historical and archaeological resources, encouraging scenic qualities, supporting public facilities and the national interest, and fostering intergovernmental coordination. As stated in MCP, these goals are intended to promote decisions that balance development with the environment. Policies of the State associated with MCP, as stated in Mississippi Codes, are detailed in Section III.C.5. of Final EIS 94/98/102. The policies are concerned with the preservation of coastal wetlands, reasonable industrial expansion, the national interest, the historical and archaeological resources, conservation of aquatic life, and air and water resource management.

The program also provides for the designation of Special Management Areas (SMA's) and the adoption of management plans for such areas. SMA designation does not create new regulatory authority, but does commit the general regulatory provisions of the program to the implementation of SMA plans.

Two regional organizations are at work in the coastal region of the state. They are the Southern Mississippi Planning and Development District and the Gulf Regional Planning Commission. In addition, MCP activity is conducted with city and county government, local industrial development districts, and various substate agencies, cities, and counties.

Louisiana Coastal Resources Program

The basis for the Louisiana Coastal Resources Program (LCRP) is Act 361, the State and Local Coastal Resources Management Act of 1978 (La. R.S. 49:213.1). The Act puts into effect a set of State coastal policies and coastal use guidelines that apply to coastal land and water use decisionmaking. A number of existing State regulations are also incorporated into the program, including those concerned with oil and gas and other mineral operations; leasing of State lands for mineral operations and other purposes; waterbottom pipelines; hazardous waste and radioactive materials; management of wildlife, fish, other aquatic life, and oyster beds; endangered species; LOOP; and air and water quality.

The Act also authorized establishment of SMA's. Included or planned to be included as SMA's are LOOP, Marsh Island, artificial barrier islands to protect deteriorating coastal areas, and freshwater and sediment diversion projects to offset land loss and saltwater encroachment.

The coastal use guidelines are based on seven general policies outlined in Act 361. They are implemented through coastal use permits and in-lieu permits. In-lieu permits provide for the use of permit requirements existing before the Act took effect to fulfill the role of coastal use permits, thereby avoiding duplicative permitting procedures.

Act 361 identified a number of uses of State concern subject to coastal use permitting requirements. Uses of State concern listed in Act 361 that could be relevant to a sale and its possible direct effects and associated and nonassociated facilities are (a) any dredge and fill activity which intersects more than one water body, (b) projects involving the use of state-owned lands or water bottoms, (c) national interest projects, (d) pipelines, and (e) energy facility siting and development.

Four Regional Planning Commissions (RPC's) are involved with the coastal area of Louisiana. The RPC's act in an advisory capacity to local units of government, State agencies, and local groups.

Texas Coastal Management Program

In May 1981, the State of Texas formally withdrew from the Federally sponsored coastal zone management program. In place of a coastal zone management plan with certain mandated features of the Coastal Zone Management Act of 1972, Texas has a network of 14 State agencies involved in the regulation of coastal resources. This network is held together by an MOU between State agencies. The MOU exists to accomplish the following:

(a) improve coordination between State agencies;

(b) require State agencies to collect data and conduct impact assessments in order to approve, deny, or conditionally approve proposed projects; and

(c) encourage State agencies to participate on a voluntary basis so as to avoid a duplication of effort, overlaps, and conflicts between agencies.

The Texas State coastal management program is decentralized. The General Land Office of Texas, operating under authority vested in an elected commissioner by the Texas Coastal Public Land Management Act of 1973, coordinates the permitting system conducted by the State. The General Land Office reviews and recommends actions to be taken based on permit applications received from the U.S. Army Corps of Engineers and Texas State agencies with statutory permitting authority. The program area of jurisdiction is public land/waters under tidal effect including bays, rivers, and the Gulf of Mexico out to the 3-league line. Most of the activities reviewed have to do with oil and gas development, dredging, and spoil areas.

Five regional planning units are operating in the Texas coastal area. These Councils of Government (COG) provide technical assistance to their member cities and states. In the face of limited regulatory powers, COG's have a limited impact on coastal resource management.

5. Offshore Oil and Gas Industry in Federal Waters

The infrastructure for oil and gas production in the Gulf of Mexico is the most developed in the world. It includes oil refineries, petrochemical and gas processing plants, supply bases for offshore services, platform construction yards, pipeline yards, and other industry-related installations. This infrastructure is highly concentrated in the coastal areas of Louisiana and eastern Texas, and to a lesser extent, along the southern half of the Texas Gulf Coast and east of Louisiana as far as Mobile, Alabama. Visual No. 1 provides a graphic display of the extent and concentration of the Gulf region infrastructure with tabulation on the back of the visual.

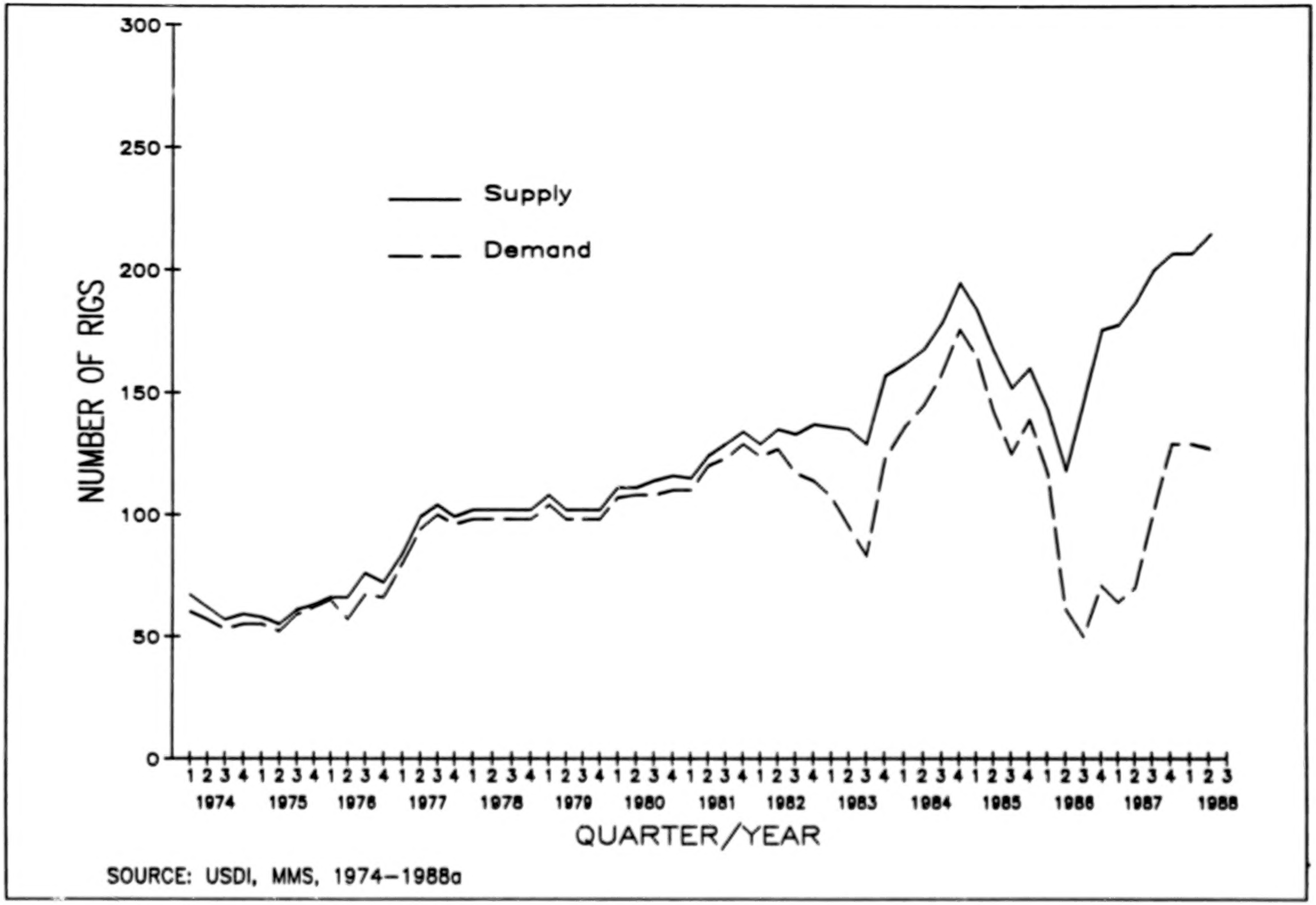
The Gulf of Mexico offshore oil and gas industry has experienced dramatic changes over recent years. Figures III-6 through III-8 illustrate the trends in Federal offshore mobile rig utilization, leased Federal OCS acreage, and U.S. hydrocarbon wellhead prices, respectively. These graphs, which cover the period from 1974 through half of 1988, clearly indicate the volatility of the offshore industry since 1981.

In Figure III-6, Mobile Rig Utilization, the supply curve represents the total number of mobile drilling rigs available in the Gulf of Mexico. The demand curve represents only those rigs working in Federal OCS waters (or the supply less the number of rigs that are stacked or in shipyards). Federal offshore mobile rig demand decreased significantly between the end of 1981 and mid-1983. In the midst of this decline, however, industry continued to expand its capacity in response to earlier years of growth. This is illustrated by the supply curve in Figure III-6, which remained fairly stable even though demand for mobile rigs decreased.

The institution of the areawide Federal offshore leasing program in mid-1983 provided a significant boost to the declining oil and gas industry. The total amount of leased OCS acreage jumped from 11.7 million acres in the second quarter of 1983 to 19 million acres in the fourth quarter of 1984 (Figure III-7). Offshore rig utilization increased dramatically from mid-1983 through the fourth quarter of 1984.

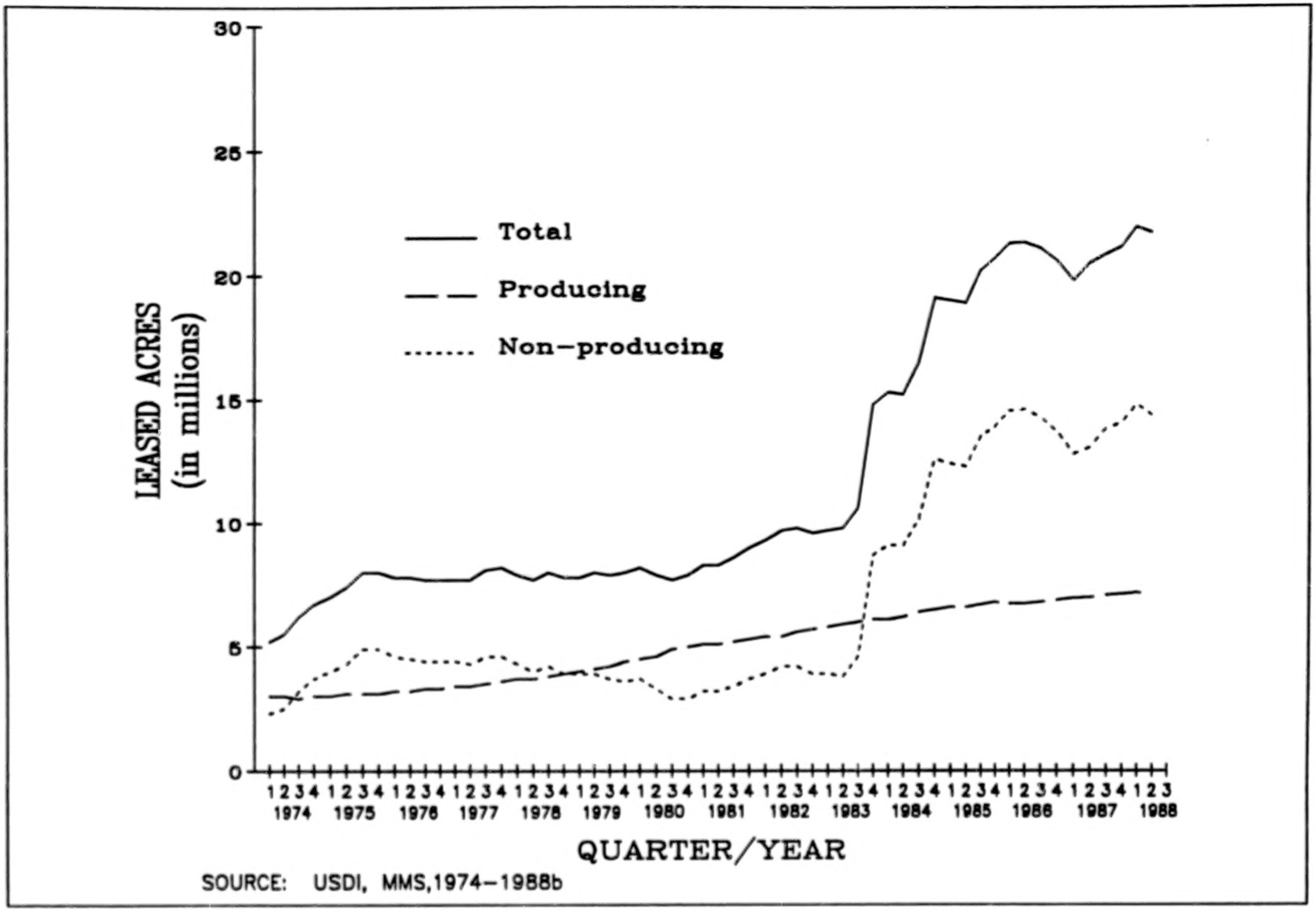
By the first quarter of 1985, the recognition of a continued excess supply of oil and gas worldwide halted the growth of offshore drilling activity in the Gulf of Mexico. Wellhead prices of oil and gas showed a declining trend throughout 1985 before plummeting to approximately 50% of the 1985 year-end prices by the second quarter of 1986. Despite continued offshore Federal areawide lease sales in the Gulf of Mexico, offshore drilling has decreased drastically throughout 1985 and 1986. The latter quarters of 1987 and early 1988 has shown an increase in the demand for mobile rigs with the slight upward trend in prices at that time and the continuation of areawide leasing. However, offshore mobile rig utilization as of the second quarter of 1988 still falls far short of the peak in December 1984.

Although there have been fluctuations in mobile rig utilization and hydrocarbon wellhead prices, producing leased OCS acreage has increased steadily since 1974 (Figure III-8). As of May 1988, there is a total of 21.6 million acres currently under lease, and, of this total, 7.3 million acres are producing.



SOURCE: USDI, MMS, 1974–1988a

Figure III-6: Mobile Rig Utilization, Gulf of Mexico OCS Region (1974 to present).



SOURCE: USDI, MMS,1974–1988b

Figure III-7: Leased OCS Acreage, Producing and Non-Producing, Gulf of Mexico OCS Region, (1974 to present).

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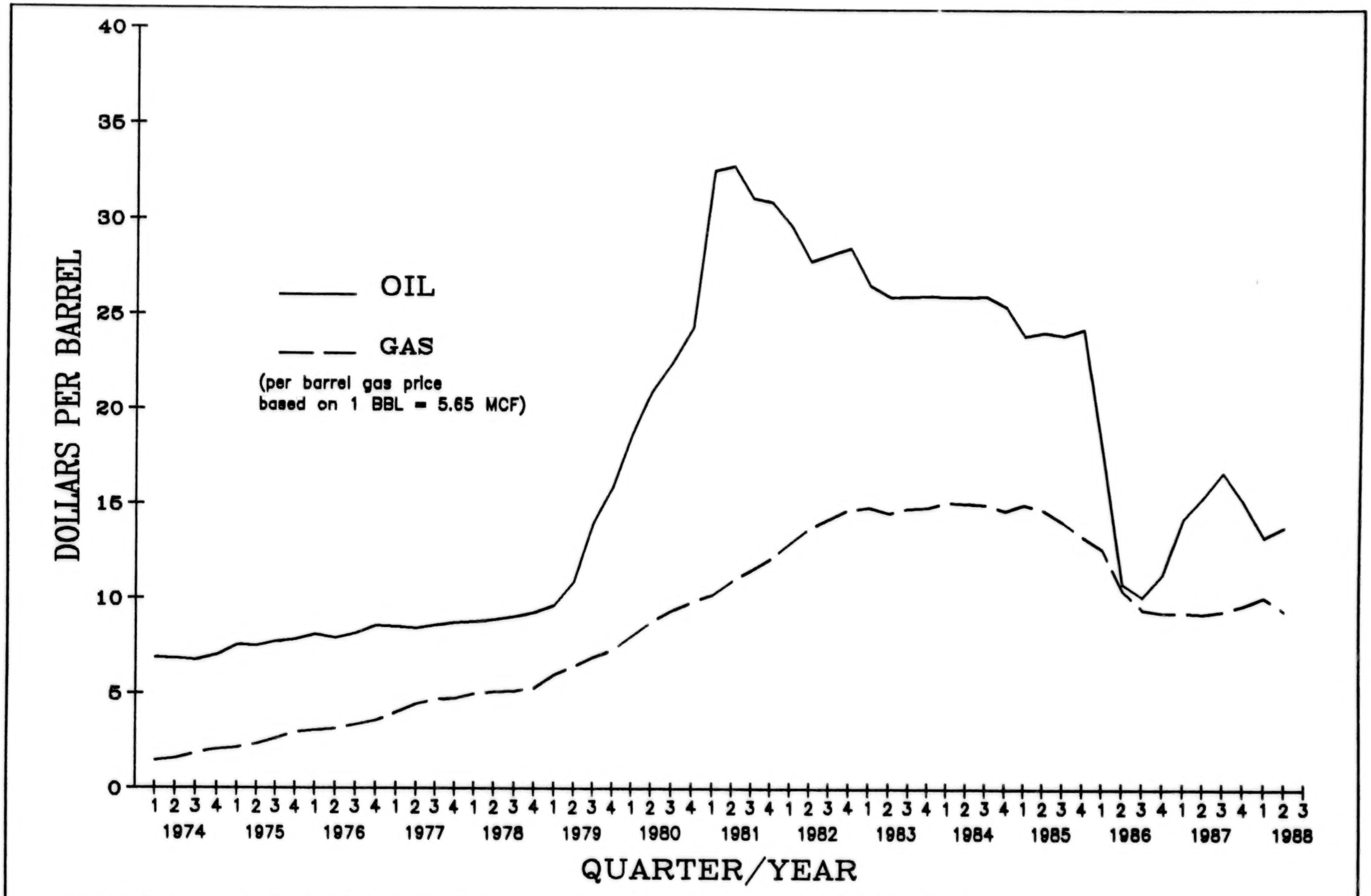


SOURCES: U.S. Dept of Energy. Energy Information Administration. 1988a and b.

Figure III-8: Hydrocarbon Wellhead Prices (1974 to present).

In summary, the current situation is an offshore sector that has a significant idle capacity of equipment and labor. This idle capacity and low levels of drilling are expected to continue until the wellhead price of oil and gas stabilizes at a higher level.

Figures III-9 and III-10 graphically illustrate the production and production value of oil and natural gas in Louisiana and Texas. It is interesting to note that oil and condensate production peaked in 1972 at 389.3 million bbls while the production value of oil and condensate reached its highest level, $10.2 billion, in 1984. Oil and condensate production actually decreased during the period from 1972 to 1980, while production value increased during that same period. From 1980 to 1986, production increased steadily while the production value stabilized somewhat and then decreased from 1985 to 1987. Natural gas production in Louisiana and Texas reached its highest level in 1981 at 4,836.8 bcf. The production value of natural gas peaked in 1984 at $12.7 billion. The value of gas production has declined from 1985 through 1987 while the volume has fluctuated in that time frame.

In relation to the MMS offshore leasing program, the exploration and production of crude oil and gas is classified as a primary industry. The processing of crude oil and gas in refineries, natural gas plants, and petrochemical plants are secondary industries. While detailed employment information strictly related to offshore activity in the Gulf of Mexico is not readily available, data for selected Standard Industrial Classification (SIC) codes from the annual U.S. Bureau of the Census' *County Business Patterns* can be used to estimate such employment and related economic effects on the coastal region. The latest issue of *County Business Patterns*, published in March 1987, contains 1985 data. The results of the most recent MMS Gulf of Mexico OCS Region offshore employment analysis are discussed in the following paragraph. The specific SIC codes used in the analysis include:

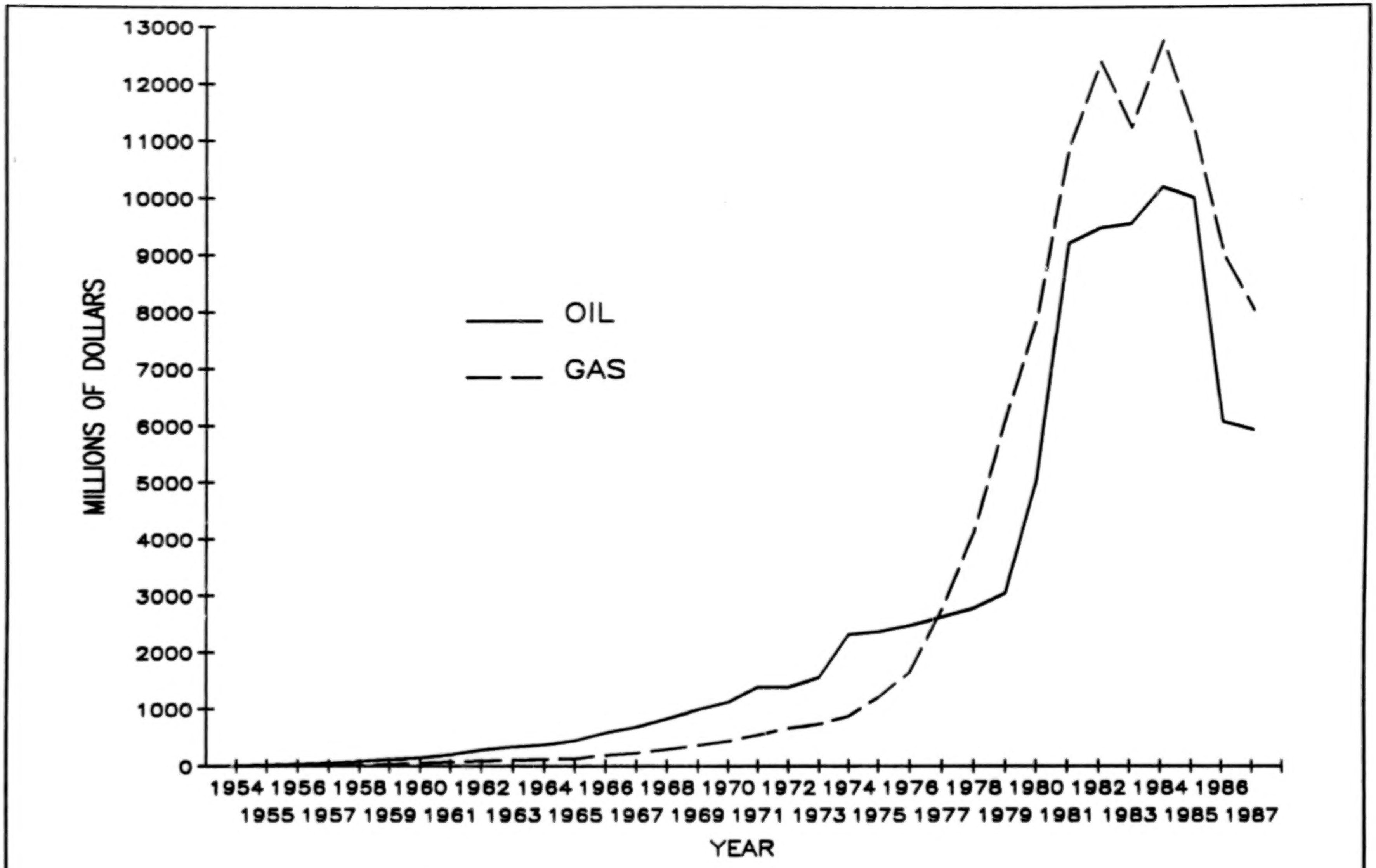
13 - oil and gas extraction
29 - petroleum and coal products
3533 - oil field machinery
46 - petroleum pipelines
492 - gas production distribution
517 - petroleum and petroleum products

These SIC codes can be utilized to further identify the extent of direct and indirect employment in the oil and gas industry. SIC 13, which is the code that includes crude oil and gas production, is the primary industry from which direct employment estimates are obtained. The other codes listed identify secondary industries that form the base for estimating indirect employment. Excluded from this analysis are some SIC codes that include OCS-related industries within broader categories of data (i.e., SIC 3731 includes shipbuilding and mobile rig fabrication). Finally, there are numerous tertiary industries not shown above that are affected by both direct and secondary industry employment. Such tertiary industry activity, however, is included in the MMS employment analysis and is shown as induced employment. The OCS oil and gas production, particularly offshore Louisiana, has been a major source of employment and revenue in the study area since 1954.

Based on the 1985 Census data, the average annual payroll associated with oil and gas activities amounts to approximately $1.9 billion for the Gulf Coast region ($1.5 billion for the Central Gulf and $0.4 billion for the Western Gulf). Average annual tax dollars generated per employee in the offshore oil and gas program are estimated at 8% of payroll revenues. Thus, the total amount of State and local taxes generated annually by the Federal offshore oil and gas program is estimated at $116.2 million from the Central Gulf and $32.5 million from the Western Gulf.

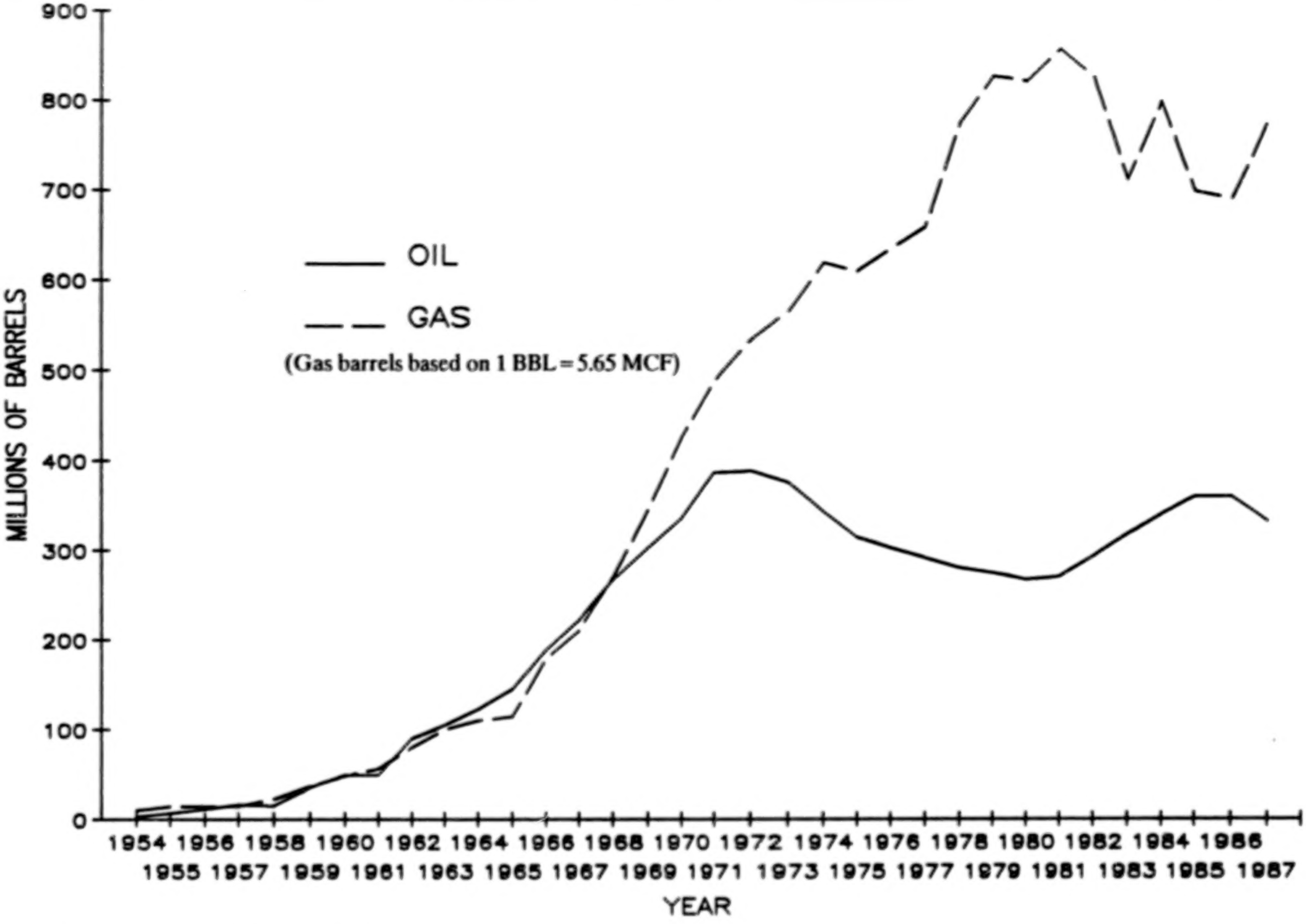
Job estimates as of June 1988 show that 83,600 jobs are directly or indirectly dependent on the offshore program. Approximately 67,700 of these jobs are associated with activity in the Central Gulf and 15,900 are related to the Western Gulf. Nearly all offshore-related employment in the Central Gulf is due to activity offshore Louisiana. Estimates of direct employment offshore are as follows: 32,000 workers in the Central Gulf and 7,500 workers in the Western Gulf.

Employment conditions as of June 1988 represent a 33% decline in the study area. Currently, there is little information available that quantifies impacts related to the oil and gas industry from the previous peak, which occurred in December 1984. From an employment standpoint, the Gulf of Mexico coastal region has suffered considerable losses. This, in turn, has affected the amount of tax revenue generated in the study area. Currently, there is little information available that quantifies impacts related to the decline of the oil and gas industry on the



SOURCES: Rawlings, 1985–1988
USDI, MMS, 1984a

Figure III-9: OCS Oil and Gas Production Values, Offshore Louisiana and Texas (1954 to present).



SOURCES: Rawlings, 1985–1988
USDI, MMS, 1984a

Figure III-10: OCS Oil and Gas Production, Offshore Louisiana and Texas (1954 to present).

economy as a whole. However, MMS is currently in the process of collecting information on depressed local economic conditions in the Gulf of Mexico OCS region. Both in-house and contract studies are forthcoming.

6. Marine Transportation and Ports

Waterborne commerce has maintained a constant presence in the Gulf of Mexico since long before the first oil and gas structure was emplaced. Over the years, an extensive shipping pattern developed in relation to the locations of the major Gulf ports and the Straits of Florida and Yucatan. As oil and gas development began to move offshore, the potential for conflicts between marine transportation and oil and gas activities became a concern. Since 1960 MMS has recorded collisions of varying severity involving vessels and fixed structures on the OCS at an average of about one in a two-year period. The volume of traffic involved in offshore support created some congestion problems and increased the potential for collisions between vessels.

The key mitigation factor for these problems was the establishment of a series of safety fairways or traffic separation schemes (TSS's), and anchorages to provide unobstructed approach for vessels using U.S. ports (Visual No. 3). Shipping safety fairways are lanes or corridors in which no fixed structure, whether temporary or permanent, is permitted. TSS's increase navigation safety by separating opposing lanes of vessel traffic. Fairway anchorages are areas contiguous to and associated with a fairway, in which fixed structures may be permitted within certain spacing limitations (33 CFR 166).

Fairways play an important role in the avoidance of collisions on the OCS, particularly in the case of the larger oceangoing vessels, but not all vessels stay within the fairways. Many others, such as fishing boats and OCS support vessels, travel through areas with high concentrations of fixed structures. In such cases the most important mitigation factor is the requirement for adequate marking and lighting of structures. After a structure has been in place for a while, it often becomes a landmark and an aid to navigation for vessels that operate in the area on a regular basis. Most ocean-going vessels are equipped with radar capable of aiding navigation in all weather conditions. This has contributed to safe navigation on the OCS.

A substantial amount of domestic waterborne commerce along the Gulf Coast does not use open Gulf waters. Vessels engaged in this activity generally use the Gulf Intracoastal Waterway (GIWW) which follows the coastline inshore and through bays and estuaries from Fort Meyers, Florida, to Brownsville, Texas (Visuals Nos. 1 and 1E).

Gulf Coast ports serving waterborne commerce include some of the busiest in the nation. The six Gulf region Customs Districts were responsible for approximately 15% of the total imports and exports for the entire United States during 1985. A number of ports in the Central and Western Gulf have developed into important centers for offshore support. The most active of these are (from east to west) Venice, Morgan City, Intracoastal City, and Cameron in Louisiana and Sabine Pass, Port O'Connor, and the Ingelside-Aransas Pass-Port Aransas area in Texas (Visual No. 1). Use of these areas is down significantly because of the recent slump in the oil and gas industry, but it is expected that they will continue to be the primary onshore bases for Gulf of Mexico OCS activities.

7. Military Use/Warning Areas

The air space over the Gulf of Mexico is used extensively by DOD for conducting various air-to-air and air-to-surface mission operations. A series of nine military warning areas and five water test areas are located within the Gulf. These warning and water test areas are multiple use areas, wherein military operations and oil and gas development have coexisted without conflict for many years. For the location of the military warning status areas in the Central and Western Gulf of Mexico, see Visual No. 3.

Use of offshore areas by DOD is provided for in 32 CFR 252. DOD policy of joint usage and coordination with DOI to ensure compatibility between agency programs is expressed within the regulation.

Military warning areas are established through the FAA Handbook 7400.2B, Part 5, Chapter 15, in which the FAA sets aside an air space area for military use. The military is not given a first use or a priority use of any area; instead, the FAA institutes a military warning area for purposes of air traffic control. The FAA handbook also refers to an Executive Order that calls for a coordination between the Departments of Transportation, State, and Defense on the establishment and use of warning areas in international waters (international waters are considered by the FAA as anything beyond the State/Federal boundaries). By the mechanisms through which the military warning areas are established and maintained, however, DOD or any other agency cannot restrict the use of a warning area, nor are any means of enforcement provided. The Defense Mapping Agency publishes the name of the user agency, area boundaries, and times of use in a semi-annual Department of Defense Flight Information Publication, *Special Use Airspace, North and South America.*

The five Eglin Water Test Areas were established by a letter of agreement between the Jacksonville Armament Research and Test Center (ARTC), Houston ARTC, Miami ARTC, and Eglin Armament Division on April 26, 1971.

The Central Gulf has three warning areas used for military operations. They total approximately 4 million acres or 7.6% of the water and air space of the sale area. The portions of the Eglin Water Test Areas located in the Central Gulf comprise another 4 million acres or 7.3% of the Central Gulf.

Warning Areas	Defense Operations Conducted
W-92	Air-to-air gunnery, rocket firing, sonar buoy operations
W-453	Air National Guard training
W-155A and B	Carrier operations, carrier pilot training
EWTA-1	Rocket and missile testing and research
EWTA-3	Rocket and missile testing and research

The Western Gulf has two warning areas used for DOD operations. They total approximately 12 million acres or 33% of the water and air space of the sale area.

Warning Areas	Defense Operations Conducted
W-228	Carrier operations, air-to-air gunnery, rocket firing, aircraft operations, submarine operations
W-602	High altitude training

8. Commercial Fishing Industry

The Gulf of Mexico provides 40% of the commercial fish landings and one-third of the recreational fishing activities in the continental U.S. (USDC, NMFS, 1988a). Commercial landings of all fisheries in the Gulf during 1987 totaled nearly 2.5 billion pounds, valued at about $720 million. This was an approximate 3% decline in both categories from 1986. Cameron, Louisiana was the leading U.S. port in quantity of commercial fish landings in 1987, followed by Pascagoula-Moss Point, Mississippi; Empire-Venice, Dulac-Chauvin, and Intercoastal City, Louisiana (USDC, NMFS, 1988a).

Menhaden, with landings of 2 billion pounds, valued at $70.5 million, represents the most important Gulf species in quantity landed during 1987. Shrimp, with landings of 257 million pounds, valued at $469 million, represents the most important Gulf species in value landed during 1987 (USDC, NMFS, 1988a). Other significant Gulf commercial fisheries include oysters, blue crabs, and an assortment of finfish.

Commercial harvest of both oysters and crabs takes place in Gulf bays and estuaries. The Gulf oyster fishery accounted for 46% of the national total with landings of 18.4 million pounds of meats, valued at about $42 million. The Gulf blue crab fishery accounted for 34% of the national total with landings of 67.6 million pounds, valued at $24 million (USDC, NMFS, 1988a).

Excluding menhaden, at least nine species of commercial finfish reached a minimum of $2 million in value landed from the Gulf of Mexico during 1987. In decreasing order of value, they are yellowfin tuna, groupers and scamp, red drum, swordfish, black mullet, red snapper, black drum, vermilion snapper, and spotted seatrout.

Alabama

Alabama ranked last among Gulf states in total commercial landings for 1987 with 24 million pounds landed, valued at $44 million. Shrimp was the most important fishery landed with 17 million pounds, valued at $27 million. In addition, the following four species each accounted for landings valued at over $250,000: blue crab, American oyster, red snapper, and black mullet (USDC, NMFS, 1988a).

Mississippi

Mississippi ranked third among Gulf states in total commercial fishery landings for 1987 with 437 million pounds landed, valued at $48 million. Shrimp was the most important fishery with 13 million pounded landed, valued at about $20 million. Menhaden landings were significant during 1987 with 380 million pounds landed, valued at $14.5 million. In addition, the following six species each accounted for landings valued at over $250,000: red snapper, blue crab, American oyster, black mullet, vermilion snapper, and black drum (USDC, NMFS, 1988a).

Louisiana

Louisiana ranked first among Gulf states in total commercial fishery landings for 1987 with nearly 1.8 billion pounds landed, valued at $316 million. Nationally, the Louisiana catch ranked first in volume and second in value. Louisiana landed 45% of the shrimp, 65% of the oysters, and 80% of the menhaden harvested from the Gulf in 1987. Menhaden represents the highest quantity with 1.6 billion pounds landed, valued at $55 million. Shrimp represents the highest value with 116.3 million pounds landed, valued at $185 million. In addition, the following 10 species each accounted for landings valued at over $1 million: spotted seatrout, red snapper, vermilion snapper, bluefin tuna, yellowfin tuna, black drum, red drum, blue crab, American oyster, and swordfish (USDC, NMFS, 1988a).

Texas

Texas ranked second among Gulf states in total commercial fishery landings for 1987 with nearly 111 million pounds landed, valued at $200 million. Nationally, the Texas catch ranked 11th in volume and fourth in value. Shrimp represents both the highest quantity and value at about 92.4 million pounds, valued at $147 million. In addition, the following four species each accounted for landings valued at over $1 million: red snapper, yellowfin tuna, blue crab, and American oyster (USDC, NMFS, 1988a).

9. Recreational Resources and Activities

The northern Gulf of Mexico coastal zone is one of the major recreational regions of the United States, particularly in connection with marine fishing and beach-related activities. The shorefronts along the Gulf coasts of Alabama, Mississippi, Louisiana, and Texas offer a diversity of natural and developed landscapes and seascapes. The coastal beaches, barrier islands, estuarine bays and sounds, river deltas, and tidal marshes are extensively and intensively utilized for recreational activity by residents of the Gulf South and tourists from throughout the Nation, as well as from foreign countries. Publicly-owned and administered areas such as National seashores, parks, beaches, and wildlife lands, as well as specially designated preservation areas such as historic and natural sites and landmarks, wilderness areas, wildlife sanctuaries, and scenic rivers attract residents and visitors throughout the year. Commercial and private recreational facilities and establishments, such as resorts, marinas, amusement parks, and ornamental gardens, also serve as primary interest areas and support services for people who seek enjoyment from the recreational resources associated with the Gulf.

Visual No. 3 provides a synoptic view of the location, extent, and components of the specific recreational resources onshore and offshore within the Gulf of Mexico region. From selected statewide/regionwide statistics, general feeling for the relative distribution of people, resources, and activities associated with the Gulf of Mexico may be obtained. Although most of the statistics are quite broad, it can be deduced that over 38 million residents of Gulf coastal states have a major interest in water-related and water-enhanced recreational activity. For one thing, approximately two-thirds of the Gulf shorefront is composed of beach. Further, there is one motor boat for about every 21 people living in the Gulf Region. More specifically, approximately 13.5 million people, or 35% of the Gulf States population, live in the area most directly affected by Gulf activity, and about one-third of the registered boats are likely candidates for marine recreational activity (16' or greater).

The two major recreational areas most directly associated with offshore leasing and potentially affected by it are the offshore marine environment and the coastal shorefront of the adjoining states. The only major recreational activity occurring on the OCS is offshore marine recreational fishing and diving. Major sport species sought and caught offshore include snappers, groupers, seatrout, croakers, mackerels, amberjack, cobia, dolphin, tarpon, and billfishes. Studies, reports, and conference proceedings published by MMS and others have documented a substantial recreational fishery, including scuba diving, directly associated with oil and gas production platforms. The recreational fishing associated with oil and gas structures stems from their function as high profile artificial fishing reefs. A report on the 1984 Marine Recreational Fishery Statistics Surveys presented by NMFS (Witzig, 1986) indicates a majority of the offshore recreational fishing in the CPA is directly associated with oil and gas structures. There are currently about 4,000 offshore oil and gas structures in the CPA and WPA. Many other studies (Ditton and Auyong, 1984; Roberts and Thompson, 1983; Ditton and Graefe, 1978; Dugas et al., 1979) have demonstrated that when oil and gas structures are accessible to marine recreational fishermen and scuba divers they are a major attraction for marine recreational activities and are a positive influence on tourism and coastal economies. Interest is high throughout the Gulf of Mexico region to convert, where feasible, selected oil and gas structures in the marine environment to dedicated artificial reefs to enhance marine fisheries when the structures are no longer useful for oil and gas production.

There have been very few recent Gulf regionwide investigations producing use data focusing specifically on marine-related recreational activity; one exception is the 1985 Marine Recreational Fisheries Statistics Survey for the Gulf and Atlantic Coasts (USDC, NMFS, 1986), which indicates approximately four million residents from the Gulf states fished in the Gulf of Mexico or its associated marine waters during 1985 and harvested approximately 145 million marine fish. Twenty-one percent of the total number of fish taken in 1985 were caught in the Gulf at distances greater than three miles from shore. Over the past five years there has been an average of 20 million saltwater fishing trips per year in the Gulf of Mexico region.

As noted on Visual No. 3, the coastal shorefront of the CPA and WPA contains extensive public and private park and recreational areas. Most of the outdoor recreational activity focused at the Gulf of Mexico shorefront is associated with accessible beach areas. Major recreational beaches are delineated on the front of Visual No. 3 and individually listed and further described on the back of this visual. Approximately 150 miles of linear shorefront in the WPA, or over 25% of exposed Texas shoreline, is composed of major recreational beaches. Less than 10% of the CPA shorefront is composed of major shorefront recreational beaches; however, the Mississippi and Alabama shorefronts are noted for their extensive recreational beaches.

According to NOAA (Meade and Leeworthy, 1986) in FY 1982, $525 million in public funds were spent for outdoor recreation in coastal counties of the Gulf of Mexico Region, an average of $44 per resident. Total public recreation expenditures and expenditures per capita are less in the Gulf Coastal Region than any other coastal region of the United States (Pacific, South Atlantic, and North Atlantic). Notwithstanding the Gulf's bottom-of-the-barrel average ranking, three South Florida coastal counties (Dade, Palm Beach, and Broward) and one Texas coastal county (Harris) ranked among the top 20 coastal counties in the nation (1,339 counties) for public recreation expenditures in FY 1982. This is not surprising, considering tourism is Florida's number one industry and local governments spend considerable sums maintaining beaches. This study, along with the Recreation Visuals and the previous discussion, points out that recreational resources, activities, participation, and expenditures are not constant along the Gulf of Mexico shorefront but are focused primarily where public beaches and major urban centers are closely related.

10. Tourism Industry

According to data from a study prepared for the Alabama Bureau of Tourism and Travel by the Department of Marketing and Transportation at Auburn University (1987), tourist-related travel expenditures in Alabama amounted to about $4.3 billion in 1987, up 8% from 1986. Approximately 25% of this ($1,075,000,000) can be directly attributed to the seven-county Gulf Region. The Gulf Region includes Washington, Clarke, Monroe, Conecum, Escambia, Baldwin, and Mobile Counties. Such travel expenditures generated more than 78,000 jobs as well as $160 million in State retail sales tax collections, excluding gasoline receipts. About 12 (21% of Alabama residents and 11% of nonresidents) cited Alabama Gulf Coast beaches as their destination. The highest percentage use of the Alabama Gulf Coast beaches was in the summer (18%) and spring (12%) months, with the lowest use occurring in fall (7%) and winter (6.3%). Lower expenditures per party in winter than in other seasons were also noted. According to the Alabama Report, going to the beach was one of three activity types generating the largest expenditures per party. The average expenditure per travel party visiting beaches was $482, up 32% from 1986. Of each dollar spent, 29 cents went for food/beverage, 29 cents for lodging, 16 cents for automobile expense, 10 cents for entertainment, 4 cents for recreation, and 12 cents for incidentals. The average number of days spent in Alabama for tourists visiting beaches was 4.9, while the averge number of nights was 4.2. The average party size was 3.4. All five of the Gulf Coast states was ranked among the top 10 states in percentage of party trips originated. These were Alabama - 55.3%, Louisiana - 6.2%, Florida - 5.2%, Texas - 4.8%, and Mississippi - 2.5%.

Data prepared for the Mississippi Department of Economic Development (U.S. Travel Data Center, 1987) indicate that in the Mississippi Gulf region, travel expenditures amounted to over $300 million, representing about 22% of comparable statewide expenditures. The highest expenditure categories were food services and auto transportation, with the lowest expenditures occurring in the categories of entertainment/recreation and public transportation. On a statewide basis, expenditures showed a 1.6% increase from the previous year. On the average, every dollar of travel expenditure in Mississippi produced 19 cents in wage and salary income during 1986. Almost $58 million, or 21% of the State's total payrolls, served as payrolls to the Gulf Coast region's 7,800 employees. On the average, every $41,000 spent by travelers in Mississippi directly supported one job during 1986. Food services accounted for 40% of the State's total payroll and 52% of the State's total employment generated by travel, while lodging accounted for 18% of payroll and 19% of employment. State and local tax receipts from the coast's travel expenditures equaled almost $19 and $6 million, respectively. On the average, each travel dollar produced 11.4 cents in Federal tax receipts, 5.7 cents in State tax receipts, and 1.4 cents in local tax receipts.

Data prepared for the Louisiana Office of Tourism (U.S. Travel Data Center, 1988) indicate that in the Louisiana Gulf region, travel expenditures amounted to over $3.2 billion in 1987, representing about 85% of comparable statewide expenditures. The highest expenditure categories were food services and auto transportation, with the lowest expenditures occurring in the categories of entertainment/recreation and incidentals. On the average, every dollar of travel expenditure in Louisiana produced 20 cents in wage and salary income during 1987. Almost $660 million, or 86% of the State's total payrolls, served as payrolls to the Gulf Coast region's 63,000 employees. On the average, every $51,000 spent by travelers in Louisiana directly supported one job during 1987. Food services accounted for 45% of the State's total jobs generated by travel, while lodging acocunted for an additional 21%. State and local tax receipts from these travel expenditures equaled $148 and $62 million, respectively. On the average, each travel dollar produced 4.6 cents in State tax receipts and about 2 cents in local tax receipts. Over 73% of the study region's travel expenditures occur in Orleans Parish, while 62% of the State's travel expenditures occur in Orleans Parish. Unlike tourism in other parts of the Gulf region, very little activity is associated with Louisiana Gulf beaches; instead, major attractions include a variety of sports events, festivals, conventions, and sightseeing activities. Although an absolute figure is not available for the number of visitors to the Louisiana coastal region in 1987, the total number of visitors to the State was 19.3 million, up 5% from 1986 (U.S. Travel Data Center, 1988). Based on travel expenditures for the coastal region, it can be assumed that 85% of the State's visitors (16 million) traveled in the coastal region.

According to data from the University of Texas at Austin (1987), total travel expenditures in the Texas Gulf region were about $5.3 billion in 1986, or [illegible] of the comparable State total. These expenditures provided almost 90,000 jobs to Texas residents in the coastal region with payrolls of about $1.2 billion. These figures represent a 5% decrease in travel-related jobs since 1984. Related State and local tax receipts for the Gulf region in 1986 were approximately $185 and $119 million, respectively. About 92% of the Texas Gulf region's travel expenditures occurred in major metropolitan areas that are in close proximity to popular Texas Gulf beaches, specifically in Cameron, Galveston, Harris, Jefferson, and Nueces Counties.

11. Archaeological Resources

Archaeological resources are any objects or features man-made or modified by human activity. Significant archaeological resources are either historic or prehistoric and, as defined by 36 CFR 60.6, generally include properties greater than 50 years old that are associated with events that have made a significant contribution to the broad patterns of our history; are associated with the lives of persons significant in the past; embody the distinctive characteristics of a type, period, or method of construction; represent the work of a master; possess high artistic values; represent a significant and distinguishable entity whose components may lack individual distinction; or have yielded, or may be likely to yield, information important in prehistory or history.

The State Historic Preservation Officers for all Gulf Coast states were contacted and requested to indicate which sites on the National Register of Historic Places within their coastal zones could potentially be affected by OCS leasing activities. These sites, which include historic buildings, forts, lighthouses, and shipwrecks, are depicted on Visual No. 3.

a. Historic

A literature search for reported ship losses and known shipwrecks was conducted as part of the archaeological resources baseline study for the northern Gulf of Mexico (CEI, 1977). From the information provided by this literature search, a breakdown of known shipwrecks and reported losses in the Gulf is given in Table III-7. Although most historic archaeological resources on the OCS are shipwrecks, other types of historic sites, such as the Ship Shoal Lighthouse, may occur in Federal waters.

Table III-7

Known Shipwrecks and Reported Losses in the Gulf of Mexico

Historic Period	Number of Wrecks*	Location Known**
1500 to 1699 A.D.	146	0
1700 to 1819 A.D.	275	1
1820 to 1899 A.D.	719	10
Total: Pre-20th Century	1,140	11
1900 to 1945 A.D.***	398	90
Unknown Date	51	9
Total: All Periods	1,589	110

* It should be noted that the above numbers are only approximations since many losses of entire fleets are listed as single wrecks and since it cannot be determined whether several wrecks reported by different sources are the same wreck or not.

** Some of the wrecks had such broad locations given (i.e., covering an entire latitude and longitude) that they were not included in the category "location known."

*** Some wrecks from this period include World War II casualties. Although most World War II wrecks may not be considered historically significant at this time, their historic significance in terms of the National Register criteria may have to be addressed within the life of the leases that result from the proposed lease sales.

The figures in Table III-7 indicate that less than 2% of pre-20th century ships reported lost in the Gulf and less than 10% of all ships reported lost between 1500 and 1945 (110 out of 1,589) have known locations. Considering the problems with inaccurate wreck reporting, drift and breakup of wrecks, and ships that have been lost but never reported, it becomes apparent that very little is really known about the locations of historic shipwrecks in the Gulf of Mexico.

To deal with the management problems of this largely unlocated and poorly enumerated resource base, a high probability zone for the occurrence of shipwrecks, Zone 1, was proposed by the baseline study (CEI, 1977). This zone was delineated by using geographic factors such as approaches to seaports, straits, shoals, reefs, and historic shipping routes as indicators of high shipwreck potential. Texas A&M University is conducting a study for MMS that will update and expand the list of historic shipwrecks given in Table III-7. It will also redefine the boundary of Archaeological Zone 1 by a more detailed analysis of the geographic factors considered in the baseline study and by consideration of other factors such as ocean currents, storm tracks, and the economic history of port development and usage. The results of this study will be available for and will be incorporated into the Final EIS for these sales.

Once a ship goes down, the spatial distribution of site materials (integrity/preservation of the sites) is governed by sea state, water depth, type of bottom, nature of the adjacent coast, strength and direction of storm currents and waves, and the size and type of construction of the vessel. The current MMS study is investigating how these variables affect site preservation. During the course of this study, an eighteenth century wreck was located in the Chandeleur area of the Gulf of Mexico. The MMS is planning to fund an investigation of this wreck to determine, in part, the effects of the preservation variables listed above on the state of an actual wreck.

Remote sensing surveys that are required prior to initiating activities within Zone 1 on the OCS have recorded evidence of approximately 57 potential wrecks. Ten of these are definite wrecks while the remaining 47 would require further investigation for positive identification. Eighty percent of these shipwrecks were recorded within Zone 1, which, according to the baseline study, is where the highest incidence of shipwrecks should occur.

In the Central Gulf, the high probability zone for shipwreck occurrence (Zone 1) is very broad, extending to the 80-m contour in some areas (Visual No. 3). In contrast, the high probability zone in the Western Gulf is much narrower, running close to the boundary of Texas' territorial waters over much of the western part of the planning area. The high probability zone is much broader, however, in the eastern part of the planning area, near the Louisiana coast, where it extends to the 40-m contour in some areas (Visual No. 3).

Based on the information provided by the archaeological resources baseline study and supplemented by information from the quarterly Defense Mapping Agency printout of Nonsubmarine Contacts, MMS records show 51 shipwrecks with known locations in the CPA and 17 in the WPA.

The major factor that would affect the integrity of shipwreck sites in the Central Gulf is the thickness of the unconsolidated Holocene deltaic sediments that blanket the seabed in the eastern part of the planning area. These sediments provide protection of site components as they settled. An excellent example of the protective aspects of this sedimentation is the recently excavated eighteenth century Spanish galleon the *El Nuevo Constante* off Cameron Parish Louisiana (*El Nuevo Constante*, 1981). The unconsolidated clays that encapsulated the wreck created an anaerobic environment that favored the near-perfect preservation of organic materials such as leather, bone, and wood. This type of wreck preservation would not be anticipated in the westernmost parts of the CPA where the bottom sediments range from outcrops of subaerially weathered clay to localized transgressive sand deposits.

In the Western Gulf, the major factor that would affect the integrity of wreck sites is the unconsolidated Holocene deltaic sediments that make up the bottom sediments in the central and western parts of the planning area. These sediments would provide some protection of site components as they settled. Preservation would probably not be so good in the easternmost part of the WPA where the bottom sediments range from outcrops of subaerially weathered clay to localized sand deposits.

b. Prehistoric

From the late Wisconsin maximum low sea stand (approximately 18,000 B.P.) until sea level reached its current high stand (approximately 5,000 to 3,000 B.P.), the Continental Shelf was subaerially exposed and inhabitable by terrestrial flora and fauna--including prehistoric man, who is known to have been in the Gulf Coast region since about 12,000 B.P. According to the sea level curve proposed for the northern Gulf by Coastal Environments, Inc. (CEI, 1982), sea level would have been approximately -45 m at 12,000 B.P. Therefore, the continental shelf shoreward of the 45-m bathymetric contour (archaeological zones 1 and 2) would have potential for prehistoric sites dating after 12,000 B.P. Further, since prehistoric sites generally occur in predictable geographic areas, the CEI study proposed that the same areas where sites of a given period occur on land will be the same areas where sites will occur on the now-submerged shelf.

Remote sensing surveys, which have been required on leases shoreward of the 45-m contour, have been very successful in identifying the geographic features that have a high probability for associated prehistoric sites. These surveys rely primarily on subbottom profiler data to interpret subsurface geomorphic features.

Regional geologic mapping studies by MMS provide a geologic framework to aid in the interpretation of lease block survey data. This regional framework allows interpretations to go beyond a statement that a relict feature occurs to an assessment of its archaeological potential in terms of its general age, the type of system to which it belongs, and the geologic processes that formed and modified it. In addition to identifying areas with a high probability for site occurrence, the potential for site preservation must also be considered as an integral part of the predictive model. In general, it may be expected that sites covered by sediments in a low energy environment (i.e., floodplains, bays, lagoons, river terraces, and subsiding deltas) before the sea's transgression of the area will have a high degree of preservation. Other protected areas (i.e., depressions, ponds, lakes, and sinkholes) and areas subjected only to low wave energy also would be conducive to site preservation. Sites on relatively steep shelves that were transgressed during periods of rapid rise in sea level may also have better potential for preservation due to the shorter period of time during which sites would have been exposed to shorefront erosion.

Although many specific areas in the Gulf have been identified through lease block surveys as having a high potential for prehistoric sites, these high-probability areas have generally been avoided by oil and gas development rather than investigated.

The eastern portion of the CPA is characterized by Holocene deltaic deposits of the Mississippi River, ranging from several hundred feet thick to only a thin veneer. Subaerially developed natural levee ridges, delta front barrier islands, bays, and lagoons are abundant in this area. Sites around bays and lagoons would have a high probability for preservation, while natural levee sites may be preserved under the right conditions. Sites associated with relict delta front barrier islands would probably be extensively reworked and incorporated into the relict barrier island sands. The thickness of archaeologically sterile open-shelf Holocene marine sediments in some areas (generally closer to the active Mississippi Delta) may preclude recovery of site information in the underlying strata.

The western portion of the CPA is generally devoid of Holocene sediments, except in the extreme western portion, where localized concentrations of transgressive Holocene sands reach thicknesses up to 7 m (USDI, MMS, 1984b). Many large, late Pleistocene fluvial systems are within a few feet of the seafloor in this area; an excellent example is provided by the ancient Sabine-Calcasieu River Valley. This ancient river valley was extensively studied and mapped by Nelson and Bray (1970) using borehole and seismic data. A study funded by MMS to locate prehistoric archaeological sites in association with the buried Sabine-Calcasieu River Valley was recently completed (CEI, 1986). Five types of relict landforms, including valley margins/floodplains, terraces, natural levee ridges, point bars, and bay/estuary margins, were identified in association with this buried river valley. These landforms were further evaluated for potential archaeological deposits through the collection of original seismic data. Based on these data, vibracores were collected to evaluate areas of potential archaeological deposits. The final phase of this study attempted site identification through laboratory analysis of the core material. These sedimentary analyses suggest the presence of at least two archaeological sites at the locations tested (CEI, 1986). Lease block surveys from other areas have recorded evidence of numerous relict late Pleistocene fluvial systems ranging from a few hundred feet across with a maximum cut of 5-10 ft, up to several thousand feet across with maximum cuts of over 100 ft. Evidence of floodplains, terracing, and point bar deposits has been recorded in association with many of these fluvial systems. Sites located along floodplains and terraces and within point bar deposits would be expected to have a higher potential for preservation than those sites located along the unprotected channel banks, although channel bank sites may also be preserved under the right conditions. Several examples of salt domes with bathymetric expression have also been recorded during lease block surveys in this area. Preservation of site materials associated with salt domes would be good within solution depressions and possibly in protected areas of rock outcrops associated with the salt dome. Due to the proximity of most of these relict landforms to the seafloor, the potential for further investigation and data recovery from these sites would be excellent.

The western portion of the WPA is characterized by Holocene deltaic deposits of the Colorado, Brazos, and Rio Grande Rivers. According to a geologic map series produced by the MMS Office of Marine Geology at Corpus Christi, Texas, the Holocene sediments west of the 96°W longitude range from approximately 12 to 143 ft thick (Berryhill and Trippett, 1981). Data from lease block surveys in this area indicate that these Holocene sediments begin thinning east of the 96°W longitude. Subaerially developed natural levee ridges, delta front barrier islands, bays, lagoons, and salt domes with bathymetric expression have been recorded as a result of lease block surveys in this area. Sites around bays and lagoons have a high probability for preservation, while natural levee sites may be preserved under the right conditions. Sites associated with relict delta-front barrier islands would probably be extensively reworked and incorporated into the relict barrier island sands. Preservation of site materials associated with salt domes would be good within solution depressions and possibly in protected areas of rock outcrops associated with the salt dome. The thickness of archaeologically sterile open-shelf Holocene marine sediments in some areas may prelude recovery of site information in the underlying strata.

The easternmost portion of the WPA is generally devoid of Holocene sediments, except in areas of localized transgressive sand deposits. Many large, late Pleistocene fluvial systems are within a few feet of the seafloor in this area; an excellent example is provided by the ancient Sabine-Calcasieu River Valley. A study funded by MMS to locate prehistoric archaeological sites in association with the buried Sabine-Calcasieu River Valley is described under the discussion for the Central Gulf of Mexico (CEI, 1986). Just north of the MMS study area, along the east Texas coast, McFaddin Beach has produced late Pleistocene megafaunal remains and lithics from all archaeological periods. Current work in this area has not allowed a definitive conclusion as to whether the site materials are eroding out of the beach deposits or are being washed onto the beach from offshore. Lease block surveys from other areas have recorded evidence of numerous relict late Pleistocene fluvial systems ranging from a few hundred feet across with a maximum cut of 5-10 ft, up to several thousand feet across with maximum cuts of over 100 ft. Evidence of floodplains, terraces, and point bars has been recorded in association with many of these fluvial systems. Sites located along floodplains and terraces, and within point bar deposits are expected to have a higher potential for preservation than those sites located along the unprotected channel banks, although channel bank sites may also be preserved under the right conditions. Due to the proximity of most of these relict landforms to the seafloor, the potential for further investigation and data recovery from these sites is excellent.

SECTION IV

ENVIRONMENTAL CONSEQUENCES

IV

IV. ENVIRONMENTAL CONSEQUENCES

A. DEVELOPMENT SCENARIOS

The Gulf of Mexico OCS Region has formulated development scenarios to provide a framework for detailed analyses of potential impacts of proposed OCS oil and gas lease sales in the CPA and WPA (Sales 123 and 125, respectively; see Figure IV-1). Each of the scenarios is a hypothetical framework of assumptions and estimates on the amounts, timing, and general locations for OCS exploration, development, and production activities and facilities, both offshore and onshore. Each scenario presents approximate activity conditions that might be associated with a sale and, thus, cannot be used to predict future oil and gas activities. Such activities are unpredictable prior to a sale; they do not become clear until offshore and onshore development proceeds from lease through production. For example, factors such as the contemporary economic marketplace and available support facilities and pipeline capacities at the time of future infrastructure development are all unknowns. Notwithstanding these unpredictable factors, the scenarios represent best assumptions and estimates on a set of future conditions that are considered reasonably foreseeable and suitable for presale impact analyses.

It should be noted that these development scenarios do not represent an MMS recommendation, preference, prediction, or endorsement of any level of leasing or offshore operations or of the types, numbers, and/or locations of any onshore operations or facilities.

1. Proposed Actions: Base Case and High Case

The Base Case and High Case described in this section are used to assess the sale-specific impacts of the proposed actions. These scenarios are based on recent trends in the following factors:

- the amount and location of leasing, exploration, and development activity;
- existing offshore and onshore oil and/or gas infrastructure;
- industry-practice information;
- oil and gas technologies and the economic considerations and environmental constraints of these technologies; and
- the estimates of undiscovered, unleased oil and gas resources in the planning areas.

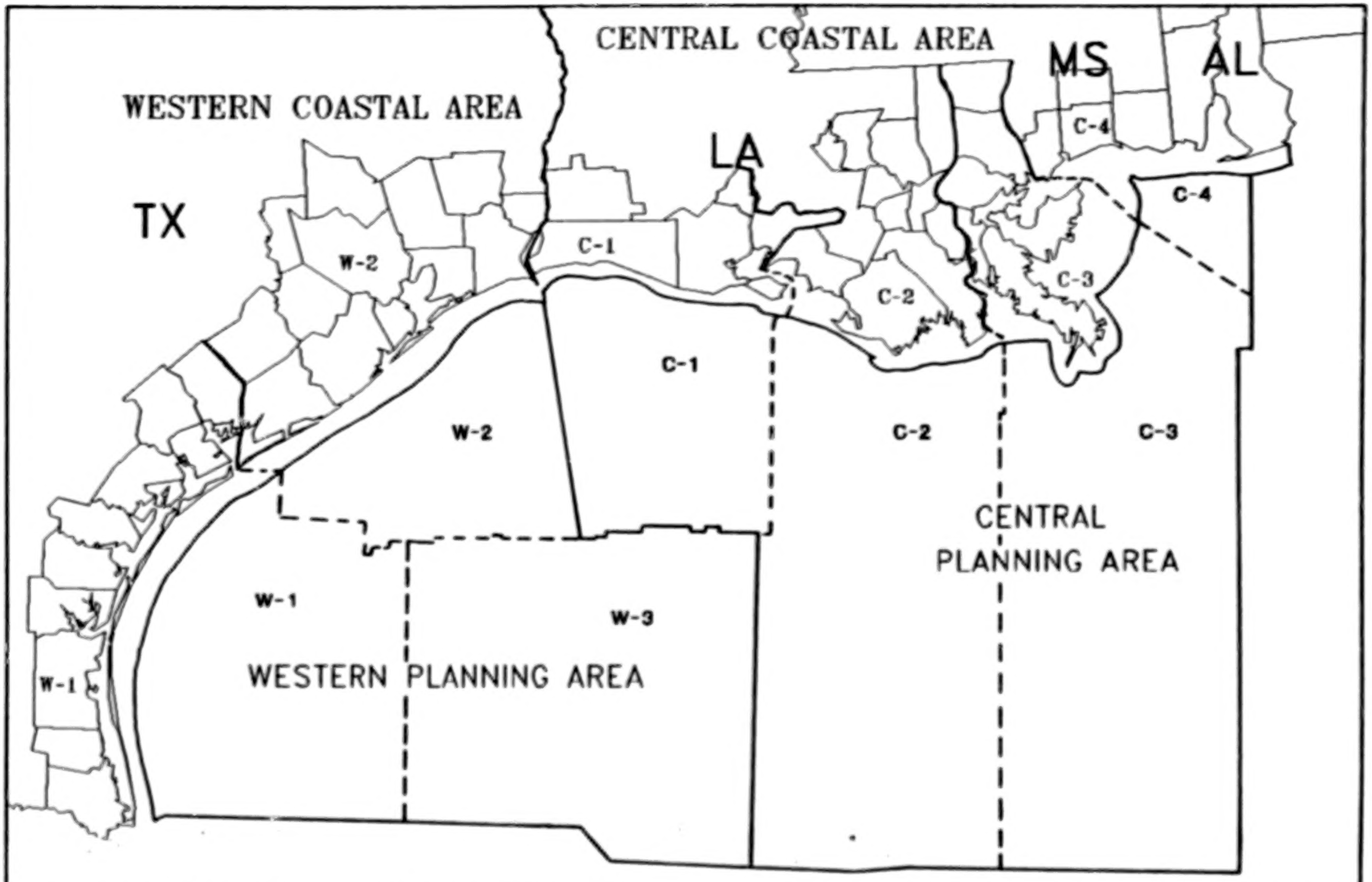
The resource estimates used for the Base and High Cases are based on two factors: (1) the conditional estimates of undiscovered, unleased oil and gas resources in the planning area; and (2) estimates of the portion or percentage of these resources expected to be discovered, developed, and produced as a result of the proposed actions. The resource estimates for the Base and High Cases differ as follows: the Base Case estimates are based on the mean or "expected" case values of total undiscovered, unleased resources; the High Case estimates, which are based on the high or 5% values, correspond to a 5% chance of that amount or more occurring.

The Base Cases--because they are based on the mean or "expected" resource estimates--are used for the principal impact analyses of the proposed sales, including the cumulative analyses. It should be noted that the base case described in Appendix C is equivalent to the term Base Case used in this EIS. The High Cases are used to provide a supplementary analysis of the effects that could occur if a greater, though much less likely, amount of resources were discovered and developed. Tables IV-1 and IV-2 provide a summary of major elements of the Base and High Cases and some of the related impact-producing factors for each proposed action.

a. Resource and Offshore Infrastructure Estimates

Central Gulf Sale 123: This proposed action is to offer for lease all unleased blocks in the CPA. As of December 1988, there were 6,011 unleased blocks containing approximately 32.1 million acres in the CPA. The actual number of blocks offered for lease will differ from the December 1988 figure by an amount equal to the number of blocks relinquished, canceled, and terminated.

The estimated amounts of oil and gas resources expected to be developed, as well as the total number of exploration and delineation wells, production platforms, development wells, and miles of offshore pipeline needed to discover, develop, and produce the estimated resources, are included in Table IV-1 for the Base and High Cases.



WESTERN COASTAL AREA
W-1
Aransas, Calhoun, Cameron, Jackson, Kenedy, Kleberg, Nueces, San Patricio, Refugio, Victoria, Willacy

WESTERN COASTAL AREA
W-2
Brazoria, Chambers, Fort Bend, Galveston, Hardin, Harris, Jefferson, Liberty, Matagorda, Montgomery, Orange, Waller, Wharton

CENTRAL COASTAL AREA
C-1
Cameron, Calcasieu, Iberia, Lafayette, Vermilion
C-2
Ascension, East Baton Rouge, Lafourche, Livingston, St. Charles, St. James, St. Mary, St. John the Baptist, Tangipahoa, Terrebonne, West Baton Rouge

CENTRAL COASTAL AREA
C-3
Jefferson, Orleans, Plaquemines, St. Bernard, St. Tammany
C-4
Baldwin, Hancock, Harrison, Jackson, Mobile, Stone

Figure IV-1: Gulf of Mexico OCS Region Planning and Analyses Areas.

Table IV-1

Summary of Major Elements of Development Scenarios and Related Impact Producing Factors during the Life of the Proposed Action (Central Planning Area)

Related to Federal OCS Activity	Prior Sales*	Sale 123 (Base)	Future Sales*	Total**	Sale 123 (High)
1. Existing					
Reserves					
Oil (billion bbls)	2.83	N/A	N/A	2.83	N/A
Gas (tcf)	27.77	N/A	N/A	27.77	N/A
Platforms	3,264	N/A	N/A	3,264	N/A
Pipelines (miles)	16,036	N/A	N/A	16,036	N/A
2. To be Developed					
Undiscovered Resources					
Oil (billion bbls)	1.84	0.17	1.16	3.17	0.33
Gas (tcf)	17.81	1.64	10.82	30.27	3.01
Total Production***					
Oil (billion bbls)	4.67	0.17	1.16	6.00	0.33
Gas (tcf)	45.58	1.64	10.82	58.04	3.01
Offshore Infrastructure					
Exploration and Delineation Wells					
Total	1,630	210	1,400	3,240	310
Peak Year	150	50	60	240	60
Platforms					
Total	160	25	100	285	50
Peak Year	24	3	4	26	5
Development Wells					
Total	3,120	290	1,930	5,340	540
Peak Year	250	20	95	280	35
Offshore Pipeline Miles					
Total	1,880	125	595	2,600	250
Peak Year	223	15	24	237	30
Transportation Assumptions					
Oil - Pipeline (billion bbls/%)	4.12/88	0.09/53	0.46/40	4.67/78	0.18/55
Oil - Shuttle Tanker (billion bbls/%)	0.55/12	0.08/47	0.70/60	1.33/22	0.15/45
Gas - Pipeline (tcf/%)	45.58/100	1.64/100	10.82/100	58.04/100	3.01/100
Transportation Activity: Peak Year Trips					
Shuttle Tanker Traffic (20,000 dwt/50,000 dwt)		15/6		102/82	29/12
Service Vessel Traffic (1,000 trips)		3.671		26.270	4.992
Helicopter Traffic (1,000 trips)		6.662		47.997	9.125
Offshore Discharges					
Drilling Mud Material (million bbls)	21.61	2.28	15.15	39.04	3.87
Drill Cuttings (million cubic feet per year)	2.43	0.26	1.70	4.38	0.43
Formation Waters (billion bbls)	40.10	1.46	9.95	51.51	2.83
Treated Sanitary Wastes (1,000 gals/day)	672	105	420	1,197	210
Sediments Disturbed by Pipeline Installation (million cubic yards)	11.28	0.75	3.57	15.60	1.50
Offshore Air Emissions Total (1,000 tons)					
Nitrogen Oxide		2.75		116.00	4.77
Carbon Monoxide		0.37		15.20	0.69
Sulphur Oxide		0.04		0.50	0.04
Volatile Organic Compounds		0.83		12.60	1.64
Total Suspended Particulates		0.00		0.22	0.01
3. Estimated Onshore Facilities (existing number/new number)					
Service Bases	30/2	30/0	30/0	30/2	30/0
Pipe Yards	8/0	8/0	8/0	8/0	8/0
Platform Yards	20/0	20/0	20/0	20/0	20/0
Pipeline Landfalls	154/2	154/0	154/0	154/2	154/0
Onshore Pipeline Miles	2,759/50	2,759/0	2,759/0	2,759/50	2,759/0
Marine Terminals	****/1	****/0	****/0	****/1	****/0
Gas Processing Plants	93/0	93/0	93/0	93/0	93/0
Oil Refineries	26/0	26/0	26/0	26/0	26/0

*For a further discussion of the parameters or specific assumptions related to prior and future sales, see Section IV.A.2.

**Total as used here equals prior, proposed action, plus future sales.

***Total production as used here equals the future production of existing reserves, plus the undiscovered resources.

****These numbers are unavailable due to a lack of information.

N/A - Not applicable.

Source: Based on MMS unpublished analyses.

Table IV-2

Summary of Major Elements of Development Scenarios and Related Impact Producing Factors during the Life of the Proposed Action (Western Planning Area)

Related to Federal OCS Activity	Prior Sales*	Sale 125 (Base)	Future Sales*	Total**	Sale 125 (High)
1. Existing					
Reserves					
Oil (billion bbls)	0.28	N/A	N/A	0.28	N/A
Gas (tcf)	9.67	N/A	N/A	9.67	N/A
Platforms	363	N/A	N/A	363	N/A
Pipelines (miles)	1,568	N/A	N/A	1,568	N/A
2. To be Developed					
Undiscovered Resources					
Oil (billion bbls)	0.48	0.10	0.68	1.26	0.22
Gas (tcf)	8.28	1.48	10.01	19.77	3.18
Total Production***					
Oil (billion bbls)	0.76	0.10	0.68	1.54	0.22
Gas (tcf)	17.95	1.48	10.01	29.44	3.18
Offshore Infrastructure					
Exploration and Delineation Wells					
Total	1,030	200	1,370	2,600	300
Peak Year	150	45	50	215	70
Platforms					
Total	90	20	80	190	40
Peak Year	10	2	4	15	4
Development Wells					
Total	1,120	220	1,450	2,790	470
Peak Year	95	15	75	135	30
Offshore Pipeline Miles					
Total	1,750	100	455	2,305	200
Peak Year	201	10	22	221	20
Transportation Assumptions					
Oil - Pipeline (billion bbls/%)	0.52/68	0.04/44	0.26/38	0.82/53	0.10/44
Oil - Shuttle Tanker (billion bbls/%)	0.24/32	0.06/56	0.42/62	0.72/47	0.12/56
Gas - Pipeline (tcf/%)	17.95/100	1.48/100	10.01/100	29.44/100	3.18/100
Transportation Activity: Peak Year Trips					
Shuttle Tanker Traffic (20,000 dwt/50,000 dwt)		11/4		90/36	23/9
Service Vessel Traffic (1,000 trips)		3.141		17.888	5.242
Helicopter Traffic (1,000 trips)		5.658		32.485	9.491
Offshore Discharges					
Drilling Mud Material (million bbls)	9.78	1.91	12.83	24.52	3.50
Drill Cuttings (million cubic feet per year)	1.10	0.21	1.44	2.75	0.39
Formation Waters (billion bbls)	6.67	0.87	5.90	13.43	1.91
Treated Sanitary Wastes (1,000 gals/day)	378	84	336	798	168
Sediments Disturbed by Pipeline Installation (million cubic yards)	10.50	0.60	2.73	13.83	1.20
Offshore Air Emissions: Total (1,000 tons)					
Nitrogen Oxide		1.98		32.50	3.87
Carbon Monoxide		0.26		4.20	0.51
Sulphur Oxide		0.02		0.30	0.04
Volatile Organic Compounds		0.66		11.80	1.21
Total Suspended Particulates		0.00		0.00	0.00
3. Estimated Onshore Facilities (existing number/new number)					
Service Bases	13/0	13/0	13/0	13/0	13/0
Pipe Yards	4/0	4/0	4/0	4/0	4/0
Platform Yards	11/0	11/0	11/0	11/0	11/0
Pipeline Landfalls	15/4	15/0	15/0	15/4	15/0
Onshore Pipeline Miles	****/100	****10	****10	****/100	****/0
Marine Terminals	****/3	****/0	****/0	****/3	****/0
Gas Processing Plants	58/0	58/0	58/0	58/0	58/0
Oil Refineries	25/0	25/0	25/0	25/0	25/0

*For a further discussion of the parameters or specific assumptions related to prior and future sales, see Section IV.A.2.
**Total as used here equals prior, proposed action, plus future sales.
***Total production as used here equals the future production of existing reserves, plus the undiscovered resources.
****These numbers are unavailable due to a lack of information.

N/A - Not applicable.

Source: Based on MMS unpublished analyses.

Also included in this table are estimates of the major impact producing factors or agents related to the estimated levels of exploration, development, and production activity.

Western Gulf Sale 125: This proposed action is to offer for lease all unleased blocks in the WPA with the exception of two unique and highly sensitive blocks in the Flower Garden Banks (Blocks A-398 and A-375 in the High Island, East Addition, South Extension Area) that have been deferred. As of January 1989, there were 5,055 unleased blocks containing approximately 27.8 million acres in the WPA (excluding the two deferred blocks). The actual number of blocks offered for lease will differ from the January 1989 figure by an amount equal to the number of blocks relinquished, canceled, and terminated, less the number of blocks leased during the intervening period.

The estimated amounts of oil and gas resources expected to be developed, as well as the total number of exploration and delineation wells, production platforms, development wells, and miles of offshore pipeline needed to discover, develop, and produce the estimated resources, are included in Table IV-2 for the Base and High Cases. Also included in this table are estimates of major impact producing factors or agents related to the estimated levels of exploration, development, and production activity.

b. Development Timetables

Central Gulf Sale 123: Under the Base Case, exploratory activity takes place over a 10-year period (1991-2000), with the most intense level of activity occurring from 1994-1995; development activity begins in 1992 with the installation of the first production platform and ends in 2017 with the drilling of the last development wells; and production of oil and gas takes place over the 1992-2023 period. Under the High Case, exploratory activity takes place over a 10-year period (1991-2000); development activity begins in 1992 with the installation of the first production platform and ends in 2018 with the drilling of the last development wells; and production of oil and gas takes place over the 1992-2023 period.

Western Gulf Sale 125: Under the Base Case, exploratory activity takes place over a 10-year period (1991-2000); development activity begins in 1992 with development activities being completed in 2018 and production activity extending through 2023. Under the High Case, exploratory activity takes place over a 10-year period (1991-2000); development activity begins in 1992 with the installation of the first production platform and ends in 2018 with the drilling of the last development wells; and production of oil and gas takes place over the 1992-2023 period.

c. Transportation Assumptions

Central Gulf Sale 123: Under both the Base and High Cases, it is assumed that all economic gas production and about 53% and 55%, respectively, of the oil production will be transported by pipeline to onshore processing facilities in Louisiana, Mississippi, and possibly Texas. An additional 125 miles (Base Case) and 250 miles (High Case) of offshore pipeline (gathering and mainlines) will move oil/gas production from production sites to the offshore pipeline network existing prior to the proposed action or to existing mainlines emplaced subsequent to the proposed action as a result of cumulative oil and gas activity, and then carried to onshore destinations. No new pipeline landfalls (pipelines moving oil and/or gas production from offshore production sites to onshore destinations) are expected to be constructed solely as a result of the proposed action under either the Base or High Cases (Table IV-1).

The recent trend to a much higher level of leasing, exploration, and potential development activity in deepwater blocks (those with an average water depth of more than 200 m) not located in proximity to the existing oil transmission system is making shuttle tankering an alternative to pipelining (in some cases it may be the only technologically or economically feasible alternative). Based on this trend, the following assumptions on the use of shuttle tankers are considered in the impact analyses: up to 47% of the total oil production will be transported to shore by shuttle tankers over a period of up to 32 years under both development scenarios (0.08 and 0.15 billion bbls under the Base and High Cases, respectively) (Table IV-1); oil transported will be from production facilities (which are likely to include floating production, storage, onloading, and single point mooring systems) in deepwater locations (in most cases exceeding 400 m) in subplanning areas C-2 and C-3; uneconomic natural gas recovered during production will be reinjected; and major onshore destinations are assumed to be existing port offloading facilities in the New Orleans to Baton Rouge Mississippi River corridor. Under the Base Case, peak oil production year trips would be 6 using 50,000 dwt tankers and 15 using 20,000 dwt tankers; while under the High Case, peak production year trips would be 12 using 50,000 dwt tankers and 29 using 20,000 dwt tankers (Table IV-1).

Western Gulf Sale 125: Under both the Base and High Cases, it is assumed that all gas production and at least 44% of the oil production will be transported by pipeline to onshore processing facilities in Texas and Louisiana. An additional 100 miles (Base Case) and 200 miles (High Case) of offshore pipeline will move oil/gas production from production sites to the offshore pipeline network existing prior to the proposed action or to existing mainlines emplaced subsequent to the proposed action as a result of cumulative oil and gas activity, and then carried to onshore destinations. No new pipeline landfalls (pipelines moving oil and/or gas production from offshore production sites to onshore destinations) are expected to be constructed solely as a result of the proposed action under either the Base or High Cases (Table IV-2).

The recent trend to a much higher level of leasing, exploration, and potential development activity in deepwater blocks not located in proximity to the existing oil transmission system is making shuttle tankering an alternative to pipelining (in some cases it may be the only technologically or economically feasible alternative). Based on this trend, the following assumptions on the use of shuttle tankers are considered in the impact analyses: up to 56% of the total oil production is assumed to be transported to shore by shuttle tankers over a period of up to 32 years under the two scenarios (0.06 and 0.12 billion bbls under the Base and High Cases, respectively) (Table IV-2); oil transported will be from production facilities (which could include floating production, storage, onloading, and single point mooring systems) in deepwater locations (in most cases exceeding 400 m) in subplanning areas W-1 and W-3; major onshore destinations are assumed to be existing port offloading facilities in the Corpus Christi, Freeport, Galveston, Texas City, Port Arthur, and Beaumont areas of Texas, as well as the Lake Charles area in Louisiana. Under the Base Case, peak production year trips would be 4 using 50,000 dwt tankers and 11 using 20,000 dwt tankers; while under the High Case, peak production year trips would be 9 using 50,000 dwt tankers and 23 using 20,000 dwt tankers (Table IV-2).

d. Onshore Facility Use Estimates

Central Gulf Sale 123: Offshore exploration, development, and production operations resulting from the proposed action are estimated to be supported from facilities located in Louisiana, Mississippi, Alabama, and Texas. Table IV-3 shows the major types and total numbers of existing facilities that could be used in conjunction with offshore exploration, development, and production, as well as their distribution by coastal subarea. Under both the Base and High Cases, all onshore service, support, and processing activity is expected to be provided from existing facilities developed (or reactivated) prior to the proposed action. No new facilities are expected to be developed solely as a result of the proposed action for either scenario (Table IV-1).

Western Gulf Sale 125: Offshore exploration, development, and production operations resulting from the proposed action are estimated to be supported from facilities located in Texas and Louisiana coastal areas. Table IV-3 provides data on the major types and total number of existing facilities that could be used in support of exploration, development, and production operations and their expected distribution by coastal subsection. Under both the Base and High Cases, all onshore service, support, and processing activity is expected to be provided from existing facilities developed (or reactivated) prior to the proposed action. No new facilities are expected to be developed solely as a result of the proposed action for either scenario (Table IV-2).

Land Use Assumptions: Sites used for new facilities (the only new facilities estimated are for the cumulative scenario) will vary in size depending on the types of facility, the amount of service/support it is established to provide, and the availability and cost of developed sites and undeveloped sites in the onshore area in which it is to be located. The following tabulation lists the average facility size (acreage per facility is shown for each major type of facility):

Facility Type	Acres per Facility
Service Bases (6 mobile rigs, 20 platforms/facility)	30
Pipe Coating and Storage Yards (400 miles of pipe coated and stored/yard/year)	100
Platform Fabrication Yards (maximum 6 platforms/yard/year)	100

Table IV-3

Onshore Facility Use Assumptions: Total OCS Analysis for the Proposed Actions*

Estimated Number of Existing and New Facilities

Central Gulf

Facility	Total		Coastal Subarea C-1		Coastal Subarea C-2		Coastal Subarea C-3		Coastal Subarea C-4	
	Existing	New	Existing	New	Existing	New	Existing	New	Existing	New
Service Bases	30	2	9	0	13	0	4	2	4	0
Pipecoating and Storage Yards	8	0	3	0	2	0	3	0	0	0
Platform Fabrication Yards	20	0	2	0	10	0	4	0	4	0
Pipeline Landfalls	154	2	53	0	57	0	42	0	2	2
Onshore Pipelines (miles)	**	50	**	0	**	0	**	0	**	50
Marine Terminals	**	1	**	0	**	0	**	0	**	1
Gas Processing Plants	93	0	43	0	33	0	12	0	5	0
Oil Refineries	26	0	10	0	4	0	8	0	4	0

Western Gulf

Facility	Total		Coastal Subarea W-1		Coastal Subarea W-2	
	Existing	New	Existing	New	Existing	New
Service Bases	13	0	6	0	7	0
Pipecoating and Storage Yards	4	0	0	0	4	0
Platform Fabrication Yards	11	0	2	0	9	0
Pipeline Landfalls	15	4	3	4	12	0
Onshore Pipelines (miles)	**	100	**	100	**	0
Marine Terminals	**	3	**	3	**	0
Gas Processing Plants	58	0	33	0	25	0
Oil Refineries	25	0	8	0	17	0

*These results are based on analyses of the proposed sales as well as sales both prior and future to the proposed sales.
**These numbers are unavailable due to a lack of information.

Source: Based on MMS unpublished analyses.

Facility Type	Acres per Facility
Marine Terminals (0.09125 billion bbls/terminal/year)	30
Onshore Pipeline Routes (per mile) (*25 miles of onshore pipeline are assumed per pipeline landfall)	*
Gas Processing Plants (0.065 tcf/plant/year)	50
Oil Refineries (49 billion bbls/refinery/year)	1,000
Pipeline Landfalls (assume an extra 40 acres for each landfall with an associated pumping station)	1\4
Direct Loss per Mile of Existing Onshore Pipeline	10
Direct Loss per Mile of New Onshore Pipeline in the Chenier Plain	2.7
Direct Loss per Mile of New Onshore Pipeline in the Deltaic Plains	4.2
Direct Loss per Mile of Navigation Channel	205

Sources: NERBC, 1976 and 1980.
Shell Offshore Inc., 1983.
Turner and Cahoon, 1988.
Visual No. 1.

2. Cumulative Scenarios for the Proposed Actions

The cumulative scenarios support the cumulative analyses, which assess future impacts (occurring subsequent to the proposed action over the period 1990-2023) to the identified resources of concern. These scenarios provide data, information, and assumptions necessary for estimating the number and characteristics of potential impact causing events that could result from construction, operation, maintenance, deactivation, and removal activities related to the following: the proposed OCS oil and gas sales; subsequent OCS oil and gas sales that are considered reasonably foreseeable; prior OCS sales; and other major non-OCS activities and occurrences. Tables IV-1 and IV-2 present a summary of the major elements in the cumulative scenarios for the proposed actions. Data shown for prior sales represent either the results of OCS activity that has already occurred on existing leases, e.g., reserves, or expected activity from lands leased prior to the proposed action, e.g., undiscovered leased resources. Information on future sales represents that portion of activity associated with sales subsequent to the proposed action, which will occur during the life of the proposed action. Thus, future sales' activity beyond the life of the proposed sale, approximately 34 years, is not included in this analysis. There are a number of other components of the cumulative scenario (not included in the summary table) that are discussed in the following sections and considered in the impact analyses.

a. Cumulative Scenario Factors Related to the Proposed Actions and Prior and Future Federal Leasing in the Gulf of Mexico

(1) Offshore Exploration, Development, and Production Activities/Infrastructure Estimates

Estimates of the amounts of Federal offshore exploration, development, and production activities/infrastructure resulting from each proposed action (under the Base Case) and prior and future leasing in the planning area of each proposed action are included in Tables IV-1 and IV-2.

(a) Central Planning Area (Central Gulf Sale 123) - Total Factors

Total undiscovered resources (related to the proposed action plus prior and future sales in the planning area) estimated to be discovered and developed subsequent to the proposed action, over the period 1990-2023, are 3.17 billion bbls of oil (BBO) and 30.27 tcf of gas. To discover and develop these resources will require the drilling of 3,240 exploration and delineation wells, the emplacement of 285 production platforms, and the drilling of 5,340 oil and gas development wells (Table IV-1).

Total production is estimated at 6.00 BBO and 58.04 tcf of gas (Table IV-1). These resources include the aggregate undiscovered resources plus the projected reserves from prior sales in the planning area as of the date of the proposed action.

All gas production and most oil production (at least 78%) will be transported to shore by pipelines to onshore processing facilities in Louisiana, Texas, and Mississippi. An additional 2,600 miles of pipeline (gathering and mainline) will be emplaced to move oil and gas production either to the existing pipeline network (extant just prior to the proposed action) or directly to shore (Table IV-1). Up to 22% of the oil production is assumed to be carried to shore by shuttle tankers.

The exploration, development, and production activities discussed in the preceding paragraphs are estimated to occur over the entire cumulative analysis period from the date of the proposed action through the year 2023. During this period, essentially all of the remaining undiscovered oil and gas resources are assumed to be leased and about 96% are estimated to be produced.

A general discussion of the major impact producing factors related to offshore exploration and development activity, including their generic effects on environmental resources, is presented in Section IV.A.3. (effluent discharges; air emissions; physical presence of drilling rigs, platforms, boats, and barges; pipeline construction; dredging activities; seismic operations; trash and debris; anchoring; and structure removal) and Section IV.B. (oil spills). Tables IV-1 and IV-2 list the total offshore effluent discharges (drilling mud material, drill cuttings, and formation waters), offshore air emissions (NO_x, CO, SO_x, and VOC), and oil spill estimates.

(b) Western Planning Area (Western Gulf Sale 125) - Total Factors

Total undiscovered resources estimated to be discovered and developed subsequent to the proposed action are 1.26 BBO and 19.77 tcf of gas. To discover and develop these resources will require the drilling of 2,600 exploration and delineation wells, the emplacement of 190 production platforms, and the drilling of 2,790 oil and gas development wells (Table IV-2).

Total production is estimated at 1.54 BBO and 29.44 tcf of gas (Table IV-2). These resources include the aggregate undiscovered resources plus the projected reserves from prior sales in the planning area as of the date of the proposed action.

All gas production and most oil production (at least 53%) will be transported to shore by pipeline to onshore processing facilities in Texas and Louisiana. An additional 2,305 miles of pipeline (gathering and mainline) will be emplaced to move oil and gas production either to the existing pipeline network (extant just prior to the proposed action) or directly to shore (Table IV-2). Up to 47% of the oil production is assumed to be carried to shore by shuttle tankers.

The exploration, development, and production activities discussed in the preceding paragraphs are estimated to occur over the entire cumulative analysis period from the date of the proposed action through the year 2023. During this period, essentially all of the remaining undiscovered oil and gas resources are assumed to be leased and about 97% are estimated to be produced.

A general discussion of the major impact producing factors related to offshore exploration and development activity, including their generic effects on environmental resources, is presented in Sections IV.A.3. and IV.B. Tables IV-1 and IV-2 list the total offshore effluent discharges (drilling mud material, drill cuttings, and formation waters) and offshore air emissions (NO_x, CO, SO_x, and VOC), and oil spill estimates.

(2) Onshore Service, Support, and Processing Facility Use Assumptions

(a) Central Planning Area (Central Gulf Sale 123) - Aggregate Assumptions

The vast majority of required onshore service, support, and hydrocarbon processing for the estimated future offshore exploration, development, and production activities discussed in the preceding section (Section IV.A.2.a.(1)) will be provided from onshore facilities established and constructed prior to proposed Central Gulf Sale 123. In fact, these facilities might well have sufficient capacity to support the estimated future offshore activity. Notwithstanding this possibility, it is considered reasonably foreseeable, and in some cases likely, that additional onshore service operations will be established and that this will lead to the reactivation of inactive facilities and/or the construction of new facilities.

Table IV-3 lists by major type, the estimated number of existing facilities (active immediately prior to the proposed sale) and additional (new) facilities used in support of aggregate future (subsequent to the proposed sale) Federal offshore exploration, development, and production in the CPA. New facilities listed in Table IV-3, which are located in both the Central and Western Coastal Areas, are limited to those whose establishment would, it is assumed, be significantly influenced by the potential to serve a portion of future aggregate OCS oil and gas activities in the adjoining coastal areas. The number and potential locations for new onshore service, support, and processing facilities are discussed in relation to the coastal subarea within which they are estimated to be located.

Coastal subareas C-1 and C-2 are not estimated to be locations for new onshore support facilities (Table IV-3).

Coastal subarea C-3 is estimated to be the location for two new service bases to support exploration, development, and production activities. Potential locations (on navigable waterways) expected to be considered include the Grand Isle offshore support area (Jefferson Parish) and the Venice offshore support area on the Mississippi River (Plaquemines Parish). It is assumed that an average service base will consist of 30 acres and could service 6 drilling rigs. An average service base of 30 acres could service 20 production platforms (Table IV-3).

Coastal subarea C-4 (comprised of the Mississippi and Alabama coastal counties) is estimated to be the location for a number of new facilities related to transporting and storing oil and gas. Two pipeline landfalls--one oil and one gas--with an associated 50 miles (25 miles per landfall) of onshore pipeline routing would be required. It is assumed that 1/4 acre will be used per pipeline landfall with an additional 40 acres per pipeline landfall, for a total of 1/2 acre. There are several potential locations expected to be considered in Jackson and Mobile Counties that would be suitable to the pipeline operations and that would probably be permitted by State and local regulatory authorities. One new marine terminal is estimated to be necessary to coincide with the one projected oil pipeline landfall and one onshore oil pipeline. It should be noted that the estimated new activity is a result of production of existing leased resources and not associated with the proposed action or with future sales (Table IV-3).

(b) Western Planning Area (Western Gulf Sale 125) - Aggregate Assumptions

The vast majority of required onshore service support and hydrocarbon processing for the estimated future offshore exploration, development, and production activities discussed in the preceding section (Section IV.A.2.a.(1)) will be provided from onshore facilities established and constructed prior to proposed Western Gulf Sale 125. In fact, these facilities might well have sufficient capacity to support the estimated future offshore activity. Notwithstanding this possibility, it is considered reasonably foreseeable and in some cases likely that additional onshore service operations will be established and that this will lead to the reactivation of inactive facilities and/or the construction of new facilities.

Table IV-3 lists by major type the estimated number of existing facilities (active immediately prior to the proposed sale) and additional (new) facilities used in support of aggregate future (subsequent to the proposed sale) Federal offshore exploration, development, and production in the WPA. New facilities listed in Table IV-3, which are located in both the Central and Western Coastal Areas, are limited to those whose establishment would, it is assumed, be significantly influenced by the potential to serve a portion of future aggregate OCS oil and gas activity in the adjoining coastal areas. The estimated number and potential locations for new onshore service, support, and processing facilities in each coastal subarea are discussed in the following paragraphs.

Coastal subarea W-1 is estimated to be the location for a number of new facilities related to transporting and storing oil and gas. Four new pipeline landfalls--three oil and one gas (1\4 acre is assumed per landfall without a pumping station)--with up to 100 miles of onshore routing are estimated (25 miles of onshore pipeline are assumed per pipeline landfall). Potential locations in Cameron, Willacy, Kenedy, Nueces, and Aransas Counties could be satisfactory to pipeline operators and permitted by the State of Texas (all of these landfalls would be with barrier islands and would have to cross estuarine and possibly wetlands areas before reaching uplands). Three new marine terminals are projected to be built to support the three new pipeline landfalls and associated onshore pipeline routing. The average size for a marine terminal is 30 acres, with throughput per facility per year assumed to be 0.09125 billion bbls (Table IV-3).

Coastal subarea W-2 is not estimated to be the location of any new onshore facilities (Table IV-2).

b. State Offshore Oil/Gas Activities

Comprehensive information on oil and gas activities in State waters in the Gulf of Mexico region has not been compiled. However, Appendix D provides a synopsis of the available history of the lease sales in the Gulf states as well as in Federal waters. Many activities carried out in State waters prior to the 1950's were not documented or permitted in the way they are now, and information is scarce or lacking (Groat, 1984, personal communication.)

The States of Texas and Louisiana have experienced offshore oil and gas exploration, development, and production activities for over 30 years. The cumulative number of offshore wells drilled in these State waters as of January 1, 1985, has been significant (i.e., Louisiana - 4,223 wells and Texas - 1,234 wells (American Petroleum Institute, 1988). The estimated number of offshore oil and gas structures (platforms and other structures) as of December 31, 1983, are estimated at about 200 for Texas and 800 for Louisiana (USDI, MMS, 1984c). Pipelines that are located entirely within State offshore waters, wetlands, and uplands do not require permits from MMS and an accurate database for such lines is not readily available.

In Texas State offshore waters, accumulated oil and gas production to January 1, 1988, was 34.1 million bbls of oil and 3,300 billion cubic feet of gas. Annual oil production peaked in 1977 at 2.6 million bbls and by 1982 production was down to 1.8 million bbls; however, in 1985 production rose to 2.2 million bbls (Risotto and Collins, 1986). Annual oil production in 1987 was again down to 1.8 million bbls. Annual gas production peaked in 1980 at 254 billion cubic feet and by 1987 annual production had declined to 89 billion cubic feet.

In Louisiana State offshore waters, accumulated oil and gas production to January 1, 1988, was 1.442 billion bbls and 10,657 billion cubic feet, respectively. Annual oil production peaked at 72.1 million bbls in 1970 and had declined to 23.7 million bbls in 1985. Annual oil production in 1987 was 25.2 million bbls. Annual gas production reached a peak of 604 billion cubic feet in 1972, thereafter steadily declining to 225.6 billion cubic feet in 1987. For Louisiana, some information is available on leasing since 1960. The Louisiana Mineral Board conducts lease sales monthly. Between January 1962 and October 1987, the State leased 940,249 acres offshore. Between January 1980 and August 1983, the State awarded 235 leases, which totaled 223,740 acres offshore. As of January 1988, there are 237 tracts and 386,830 acres under lease offshore Louisiana.

The State of Mississippi has experienced a limited amount of offshore activity. Three exploratory wells were drilled in the 1950's. All were dry holes, and the relevant leases have expired. In 1982 the State held an offshore offering in which only one lease was granted. No exploration activity has yet occurred as a result of this lease. As a result of the success experienced in the Mobile Bay area (in Alabama State waters) 10 miles to the east of the State line, Mississippi offered the lower portion of Mississippi Sound for lease in January 1985. Several leases were granted as a result of the offering.

In FY 86, the State of Mississippi held its third lease sale, which resulted in the leasing of about 20,000 acres. In late August 1986, an exploratory oil and gas well was drilled in Mississippi coastal waters 4.5 miles south of Ship Island. Fifteen days after drilling had begun, the drilling was terminated. A depth of 5,921 ft had been reached and the drilling officials announced that no oil or gas was discovered. Currently, there is one area in Mississippi Sound under lease. Exploratory drilling is proposed for December 1988. There are no plans through mid-1989 for further lease offerings.

Oil and gas activity in the State of Alabama's offshore waters has become active over the past few years. The lower Mobile Bay Mary Ann Field was discovered in 1979. This field has estimated reserves of as much as 600 billion cubic feet of natural gas. In 1981, 1982, and 1984, the State leased 33 blocks. On February 23, 1988, Alabama held an offshore oil and gas lease sale in State waters. Approximately 90,556 acres were offered and 7 leases were awarded. On July 19, 1988, Alabama held an offshore oil and gas lease sale and 5 leases were awarded. As of August 1988, there were 37 leases in the State offshore waters. The drilling of 21 wells had been completed by July 1986 and exploration activities by a number of companies continue. Since the initial discovery of 1979, several other discoveries have been made, confirming the commercial potential of natural gas in Mobile Bay.

Development activity is well underway in the Mary Ann Field in Mobile Bay with production start-up anticipated for 1988. Construction on a new gas processing plant about 20 miles south of Mobile near Bayou LaBatre is now nearing completion. Gas production from the Mary Ann Field will be pipelined to this plant for processing and then moved by a 23-mile pipeline to connect with an existing interstate pipeline system. Development of at least one other field is currently being considered (commencement of development activity in 1990 is planned).

The State of Florida has experienced a limited amount of drilling in State coastal waters. Between 1945 and 1983, 29 exploratory wells were drilled in waters under Florida jurisdiction. These wells were drilled at sites extending along the entire Gulf Coast from Pensacola to the Keys and Dry Tortugas. None of these wells resulted in development or production. Coastal Petroleum Company holds the only active lease in Florida waters. This lease, which expires in 2016, is large in size and geographic coverage. It forms a band that extends 3 miles shoreward of the State's offshore boundary, follows the coastline for 245 miles from Apalachicola Bay to Naples, and encompasses 816,000 acres. Currently, Florida has no plans for lease sales in its coastal waters. However, there has been interest in undertaking seismic surveys in State waters adjacent to the Destin Dome and Charlotte Harbor OCS areas (Risotto and Collins, 1986). Three permits to conduct seismic surveying around the Florida Panhandle and Big Cypress areas were applied for and issued in 1986. In 1987, one permit was applied for and is currently being reviewed.

c. Major Sources of Oil Contamination in the Gulf of Mexico

Petroleum hydrocarbon inputs into the Gulf of Mexico include natural seeps, accidental spills, and long-term, low-level discharges. The presence of petroleum hydrocarbons in the marine environment is, to some extent, unavoidable. The petroleum hydrocarbons found in the world ocean are generated by both natural and geochemical processes and by anthropogenic inputs. The majority of petroleum hydrocarbons are introduced into the sea as a result of man's activities--coastal refining, industrial waste disposal, urban and river runoff, transportation losses, and offshore oil and gas activities.

Figure IV-2 illustrates estimated amounts of petroleum hydrocarbons annually entering the Gulf of Mexico from major offshore, coastal, and land-based sources. The figure summarizes an MMS analysis that was based on a parallel analysis by the National Academy of Science (1985). More detailed information on data that were used to complete the pie chart figure can be found in Table IV-26 and Appendix E of the Regional EIS (USDI, MMS, 1983a). The National Academy of Science's report "Oil in the Sea" (1985) contains a similar table (Table 2-22) which provides the same categories and gives amounts for inputs of petroleum hydrocarbons to the world ocean. The Mississippi River discharge completely dominates petroleum loadings of Gulf waters (78.3%). Natural seepage is the second largest contributor of petroleum to Gulf waters (9%). Marine transportation activities release an estimated 4.8%, with the majority of this coming from operational discharges of tankers. The OCS oil exploration and production activities add 0.6% annually to the petroleum entering the Gulf from both accidental and operational discharges.

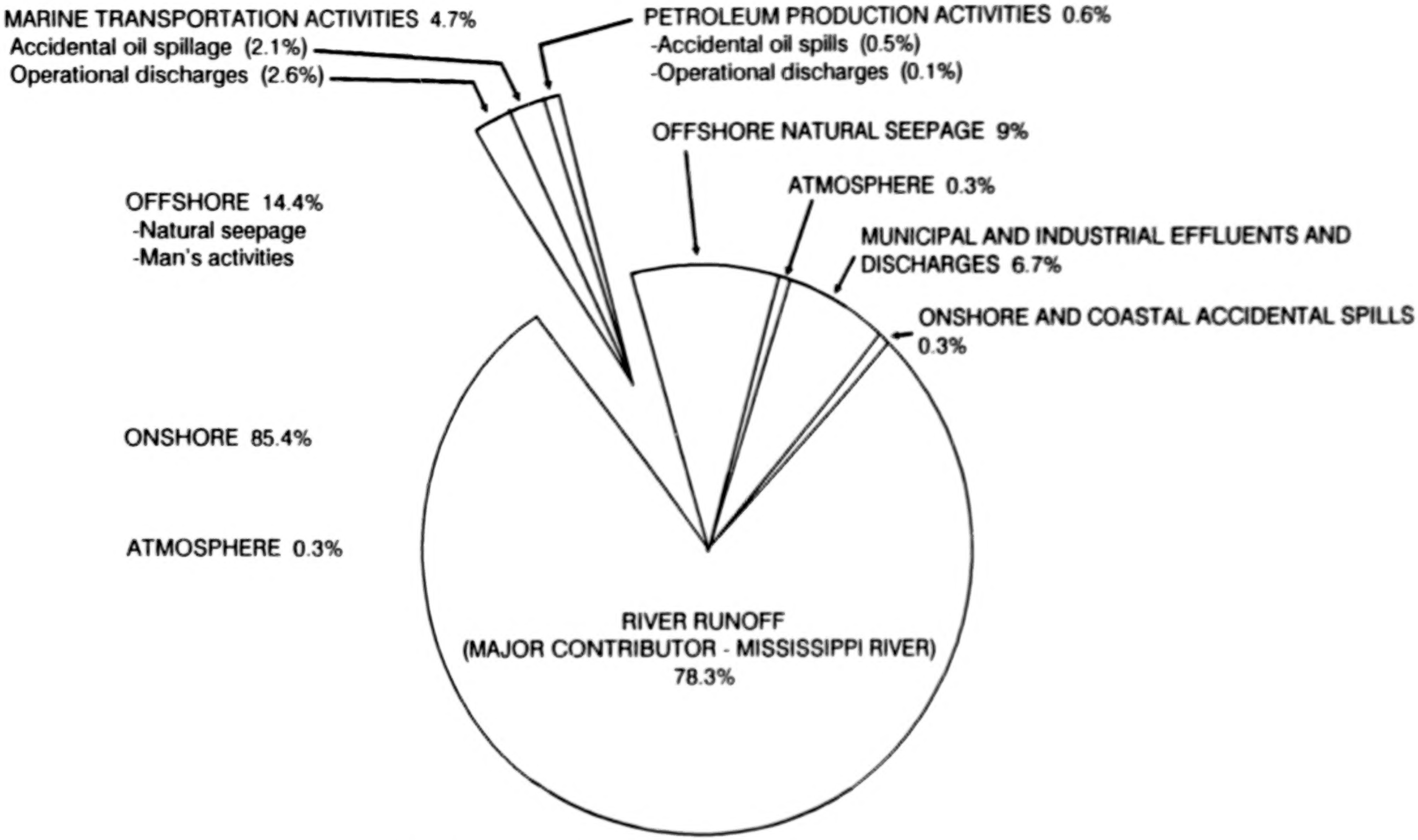
d. Other Major Offshore Activities

The Gulf of Mexico is actively utilized for a number of activities, including those of the Navy, Naval Reserve, and Air National Guard for carrier flight qualifications and pilot training as described in Section III.C.7. The Gulf also provides ample offshore recreational and commercial fishing opportunities. For further information on these two important uses of the Gulf, see Sections III.C.8. and 9.

The following discussion summarizes the other prevalent uses of the Gulf of Mexico.

(1) Marine Transportation and Tankering of Imported Crude Oil

Vessels operating offshore often utilize the network of established safety fairways as shown on Visuals Nos. 3 and 3E. Over the years, an extensive shipping pattern developed among the major Gulf ports and between the ports and destinations outside the northern Gulf via the Straits of Florida, the Yucatan Channel, and the Bay of Campeche. As oil and gas development began to move offshore, the potential for conflicts between marine transportation and oil and gas activities increased. Marine transportation is not projected to increase in future years, but it has fluctuated from year to year. Marine transportation traffic at its current or increased levels can contribute to operational errors, which might result in groundings or in collisions involving other vessels or fixed structures



*SOURCE: USDI, MMS, 1982, GULF OF MEXICO REGION ESTIMATES.

Figure IV-2: Sources of Petroleum Inputs into the Gulf of Mexico Outer Continental Shelf Waters(Annual Percentage).

such as platforms and rigs. This might lead to losses in lives, property, and possibly environmental damage if hazardous cargo is involved.

The key mitigation factor for this problem was the establishment of a series of safety fairways and anchorages to provide unobstructed approach for vessels using U.S. ports (Section IV.B.4.a.). Fairways play an important role in the avoidance of collisions on the OCS, particularly in the case of the larger oceangoing vessels, but not all vessels stay within the fairways. Many vessels, such as fishing boats and vessels supporting offshore oil and gas operations, travel through areas with high concentrations of fixed structures. In such cases the most important mitigation factor is the requirement for adequate marking and lighting of structures. After a structure has been in place for a while it often becomes a landmark and an aid to navigation for vessels that operate in the area on a regular basis.

There is a substantial amount of domestic waterborne commerce along the Gulf Coast that does not always utilize open Gulf waters. Vessels engaged in this activity generally use the Gulf Intracoastal Waterway (GIWW) which follows the coastline inshore and through bays and estuaries and in some cases offshore from Fort Myers, Florida to Brownsville, Texas (Visuals Nos. 1 and 1E).

The most significant contributions of marine transportation to cumulative impacts in the Gulf are from the tankering of imported crude oil. Extensive refinery capacity, easy port access, and a well developed onshore transportation system have contributed to the development of the Gulf Coast region as an important center for handling imported oil and production from other domestic sources such as Alaska and California (henceforth included in the category of imports). The area also includes the Nation's Strategic Petroleum Reserve (Section I.B.5.g.) and LOOP, the only deepwater crude oil terminal in the country (Section I.B.5.b.).

The major Gulf Coast ports of entry for imported oil are listed on Table IV-4. Included are the amounts of crude oil estimated to be imported into Gulf ports during the 34-year lease life. Tanker trips occurring in the Gulf would be double the number of port calls. This reflects the trip to the port and from the port-of-call.

Crude oil tankering routinely contributes to contamination of the marine environment. Operational discharges occur when oily bilge water is pumped overboard and during tank cleaning and ballasting. Tankers' bilges must be periodically pumped out to remove oil and water collected in the lower part of the ship's hull from leaking pipes, valves, and machinery. Bilge water may first be put into a settling tank to separate the oil from the water. Some vessels pump bilge water through an oil-water separator which can significantly reduce the amount of oil discharged. Oil is usually discharged during tank cleaning because some oil inevitably remains in the tanks after offloading. Also, ships that do not have segregated ballast tanks will take on seawater into "empty" oil tanks for use as ballast. When discharged, this water will contain the oil residue left in the tank. United States and international regulations generally prohibit any operational discharges within 50 miles of land and require that no more than 15.8 gallons (60 liters) of oil be discharged per nautical mile. In addition, no vessel may discharge more than 1/15,000 of its dwt (Section IV.A.2.d.).

Accidental spills normally result from collisions and groundings. There are estimated to be 33.8 large spill (1,000 bbls or greater) occurrences in the Gulf from tankering of crude oil imports over the 34 years projected as the life of the sale. The potential impacts of oil spills from crude oil import tankering and other sources are considered in the cumulative analyses.

(2) Ocean Dumping

Dredging of new channels and maintenance dredging of existing channels are required to provide safe and efficient navigation conditions for commercial and recreational marine transportation. Channel dredging generates significant amounts of dredged material consisting of the sediment and water mixture excavated from areas dredged. On the basis of volume, dredging is the largest single source of material that is ocean dumped. During 1979, more than 49 million cubic meters of dredged material was deposited in the marine environment (U.S. Dept. of the Army, Corps of Engineers, 1985). Of that total, 53% was disposed of in the Gulf of Mexico. Compared with other materials that are disposed of in the ocean, most of the dredged material excavated in the United States is relatively innocuous, in many instances containing no harmful pollutants and, in most of the remaining cases, containing only trace levels of contaminants. These physical effects include burial of organisms, increased levels of suspended sediments, and accretion of disposed materials (U.S. Dept. of the Army, Corps of Engineers, 1978). However, dredged material taken from highly polluted areas is usually contaminated with harmful chemical constituents such as heavy metals, synthetic organics, and oil and grease. Open-ocean disposal of these materials carries the threat of acute or chronic toxic effects on marine organisms and potential contamination of human food resources.

Table IV-4

Projected Crude Oil Imports: Port Calls, and Volume of Crude Oil Transported and Offloaded at Gulf of Mexico Ports during the 34-year Lease Life

Port	Volume Transported/ Offloaded[1] (billion bbls)	Port Calls[2]
Mobile, AL	0.8	2,162
Pascagoula, MS	7.5	20,270
Miss. River Ports	7.5	20,270
LOOP	11.3	8,483
Lake Charles, LA	7.5	20,270
Port Arthur, LA/Beaumont, TX	9.0	24,324
Houston/Galveston/Texas City, TX	19.6	52,973
Freeport, TX	3.0	8,108
Corpus Christi, TX	9.0	24,324
Total	75.0	176,519

[1] Estimates include domestic production transported from Alaska and California via tanker to Gulf of Mexico ports.

[2] Port calls are based on the use of 50,000 dwt tankers for all ports except LOOP, which is based on 180,000 dwt tankers.

Source: USDI, Minerals Management Service, Gulf of Mexico OCS Region estimates.

Industrial wastes may contain potentially harmful constituents including synthetic organics, heavy metals, and oil and grease. Commonly used disposal options for industrial wastes are secure landfills, ocean dumping, pipeline discharges to coastal and inland waters, and incineration. When industrial wastes are ocean dumped, the waste materials are barged to a designated disposal site and discharged. Between 1973 and 1978, some 2.6 million tons of industrial wastes were dumped into the Gulf of Mexico; however, there has been a trend toward reduction of total ocean dumping of industrial wastes since 1973 when ocean dumping became regulated by the Federal Government, and industrial waste dumping has been totally eliminated in the Gulf of Mexico.

The first incineration at sea of chemical waste officially sanctioned in the U.S. occurred in the Gulf of Mexico between October 1974 and January 1975 when M/T Vulcanus incinerated 16,000 metric tons of organo-chlorine wastes at a designated site about 140 nautical miles southeast of Galveston, Texas (U.S. Environmental Protection Agency et al., 1980). In 1977, 17,600 tons of chemical waste were incinerated in the Gulf of Mexico. From studies of these early burns, it has been concluded that incineration at sea for organic chemical wastes does not cause unacceptable environmental consequences, at least on a limited basis for some chemicals and at these specific sites (U.S. Environmental Protection Agency et al., 1980). Candidate wastes for incineration at sea are generated primarily by the following industries: petroleum refining, organic chemical production, synthetic fibers and resins manufacture, and pesticides production. Although incineration at sea has been conducted on a limited basis, it is likely to become more common in the future. Increasing amounts of industrial waste are produced each year, and increased regulatory pressure through implementation of the Resource Conservation and Recovery Act (RCRA) is eliminating some of the traditionally used land-based disposal options because of potential environmental hazards.

There is one USEPA designated dump site in the Gulf of Mexico (Visual No. 3); it is designated for incineration of hazardous wastes, but there are no active permits for incineration at sea. This site is located in deepwater seaward of the continental shelf. See Section I.B.5.d. for a discussion of the regulation of ocean dumping.

Between 1946 and 1970 the Atomic Energy Commission (AEC) licensed the dumping of more than 86,000 containers of low-level radioactive wastes at 28 recorded dumpsites in the Atlantic and Pacific Oceans and the Gulf of Mexico. Of these, only two dumps were made in the Gulf of Mexico (U.S. Environmental Protection Agency, 1980). Ocean dumping was discontinued in June 1970 following a policy recommendation by the President's Council on Environmental Quality (CEQ) in its 1970 report to the President. The United States has never disposed of its high-level wastes in the oceans, and in 1972 two major legislative initiatives were enacted prohibiting future disposal of high-level wastes into coastal waters and rivers. The Ocean Dumping Act, in addition to regulating ocean disposal of low-level waste, prohibits the dumping of high-level waste and radiological warfare agents in ocean waters. Soon after the Ocean Dumping Act was enacted, the Clean Water Act was amended to extend the prohibition to all navigable waters. Although not immediately contemplated, subseabed emplacement of high-level radioactive wastes is a future option.

(3) Deepwater Ports

The Louisiana Offshore Oil Port (LOOP) is the only deepwater port in the Gulf of Mexico. LOOP's function is to facilitate the offloading of oil from vessels too large to visit conventional Gulf ports (typically supertankers with drafts greater than 40 ft and up to 700,000 dwt) and to transport the oil to shore via pipeline. In 1987, LOOP offloaded 218,427,000 bbls of crude oil from tankers, 47 million of which was domestic, Alaskan crude. No mobile drilling operations or installation of permanent structures may take place within LOOP's designated safety zone, fairway, or anchorage. For additional information, see Section I.B.5.b.

(4) Non-Energy Minerals Program in the Gulf of Mexico

At the present time, there is one producing sulphur lease in Federal waters in the Gulf of Mexico. This is in the Caminada Mine located in Grand Isle, Blocks 16, 17, 22, and 23, and operated by Freeport-McMoran. Hot water injection began on October 7, 1988, and sulphur production began on October 24, 1988.

During the last week in October, Freeport-McMoran also spudded in an exploration well on its South Pelto 11 lease obtained in the February 1988 sale. Upon completion, the well was plugged and abandoned.

On December 31, 1986, Secretary of the Interior Donald P. Hodel and the Governors of Alabama, Mississippi, Louisiana, and Texas announced an agreement to establish a joint Federal/State task force to study the occurrence, location, and economic feasibility of developing marine mineral resources offshore those states. The task force is jointly co-chaired by representatives from the Alabama Geological Survey, the Mississippi Mineral Resources Institute (MMRI), the Louisiana Geological Survey, the Texas Bureau of Economic Geology, and MMS.

The task force has spent the past year developing an inventory of the publicly available geologic and geophysical data, identifying mineral commodities and the particular areas of potential commercial interest, and performing a preliminary economic feasibility study. A draft report was scheduled for late November1988, and a final report with recommendations for further action to the Secretary of the Interior and the Governors is scheduled for late February 1989.

Additional information regarding non-energy minerals production on the Gulf of Mexico can be found at 53 FR 25242, 54 FR 2041, and 54 FR 2057.

e. Major Onshore Activities in Coastal Areas

(1) Oil and Gas Facilities

The central and western coastal portion of the Gulf Coast has one of the highest concentrations of oil and gas activities and related and service-support processing infrastructure in the world. This onshore activity and infrastructure includes: exploratory/development drilling and production well sites and access canals and roads to these sites; oil and gas pipelines; oil refineries; gas processing plants; petrochemical plants; pumping and compressor stations; pipe coating and storage yards; platform and rig fabrication yards; service/support bases, including docking facilities; shipyards; service, repair, and maintenance service facilities; ports; and access channels to the Gulf. It is noted that with the exception of the exploratory/development/production well sites and related infrastructure, much of this onshore infrastructure is heavily used and, in some cases, is exclusively used in (or owes its existence to) support of offshore oil and gas activity, both in State and Federal waters. Visual No. 1 indicates the location of several major types of these facilities (supply or service bases, platform fabrication yards, pipecoating yards, gas processing plants, oil refineries, selected ports, and oil and gas pipeline landfalls), both graphically and in tabular format. The tabular format on the back of the visual includes the company name, capacity, and location of all gas processing plants and refineries.

In Louisiana, virtually all privately-owned lands in the coastal area have been leased for oil and gas development. There are over 34,000 wells in the coastal area (which includes the following parishes: Cameron, Iberia, Jefferson, Lafourche, Orleans, Plaquemines, St. Bernard, St. Charles, St. John the Baptist, St. Mary, Terrebonne, and Vermilion).

Access canals and pipelines to service both OCS and onshore development are pervasive throughout the coastal area. The typical dimensions of an oil and gas access canal, as indicated on permits, are as follows: a canal 1,200 feet long and 70 feet wide with a drill slip at the end measuring 345 by 160 feet. The cumulative linear extent of major navigation channels in coastal Louisiana has been estimated at 4,886 miles in 1988; 205 miles of these are primarily used for OCS onshore support operations (Turner and Cahoon, 1988).

For pipelines, it is estimated that there are 112 pipeline landfalls originating in State offshore activities and 165 existing pipeline landfalls attributable to OCS activities (Wicker and Rabalais, 1988). Recent figures compiled by the Louisiana Geological Survey show that as of December 1986 there are 9,498 miles of onshore pipelines and 2,547 miles of offshore (State waters) pipelines attributable to both State and OCS oil and gas operations (Louisiana Geological Survey, 1988). Of the 9,498 miles of onshore pipelines, 2,759 miles are assumed to primarily carry OCS product (Turner and Cahoon, 1988).

(2) Channelization, Dredging, and Mississippi River Flood Control Measures

The establishment of intercoastal waterways, irrigation and drainage canals, and access channels has resulted in extensive channelization and attendant disposal of dredge spoil throughout the coastal zone. Cuts have been made on land and in bays, estuaries, and tidal flats. Major environmental consequences of channelization and disposal of spoil in banks and piles are: (a) alteration or modification of on-land drainage patterns; (b) tendency to dam wetlands and shallow water bodies into isolated compartments, inhibiting natural circulation and altering temperature and salinity gradients; and (c) creation of unstabilized, easily eroded sediments that are reworked and redistributed by storms, normal waves, currents, and stream runoff.

Alterations in the hydrology of the Mississippi River basin have caused declines in sedimentation rates and have contributed to marsh deterioration in the coastal wetlands of Louisiana in recent decades. Coastal marshes appear to expand or diminish in areal extent according to the amount of sediment available, and sedimentation is a limiting factor controlling marsh growth. In a natural system, overbank flooding is a mechanism of introducing sediment-laden waters into adjoining wetlands. Flood control levees on the lower Mississippi River and its distributaries have contributed to wetlands loss because levees eliminate overbank flooding and prevent the distribution of alluvial sediments across the delta.

Sediment deprivation is also the result of a decrease in the sediment load of the Mississippi River as a result of river bank stabilization projects and upstream reservoir development. Land use changes, such as scientific soil conservation and reforestation programs within the basin, may also have contributed to the decrease in suspended sediment load of the river.

(3) Filling and Land Reclamation

Artificial filling of shallow coastal water bodies and low-lying marshes creates valuable shorefront development land or additional land for industrial expansion. The process also permanently destroys parts of vital natural environments, alters shoreline configurations, modifies natural patterns of circulation and sediment dispersal, and commonly creates unstabilized and easily erodable substrates.

(4) Shoreline Construction

Construction of groins, piers, and jetties, as well as channel widening and deepening and dredge disposal, have modified the circulation and sediment availability and transport patterns along the Gulf coastline and within the bays and estuaries. The erosion and accretion of a shoreline is largely controlled by natural processes, of which sediment supply and wave energy are key factors. Shoreline construction, whether in the form of shoreline control or development, can affect the natural processes and the rate at which they work.

(5) Waste Disposal

A significant activity in the coastal zone is the disposal of waste, particularly in the more populated and industrialized areas. Although many wastes are treated and discharged into water bodies and others are incinerated, a large volume of wastes are disposed of beneath or on land. Land disposal of waste may result in pollution of groundwater aquifers or surface water bodies in the event the host soils are permeable and the groundwater table is high.

Industrial ocean outfalls are pipeline discharges of industrial wastes that directly enter estuaries, coastal waters, or oceans. Ocean outfalls of industrial wastes are regulated by USEPA through NPDES. In 1979, more than 5,000 NPDES permits were held for pipeline discharges by industries in coastal counties. In addition, about 7,500 operational discharges were associated with offshore oil and gas facilities. Pollutants that may be associated with various industrial effluents include synthetic organic, heavy metals, oxygen-consuming materials, suspended solids, and nutrients. Over one-half (63 million lb/yr) of all oil discharges comes from industrial point sources. The chemical and allied products and petroleum refining, and related industries combined represent 90% of all oil discharges from industrial point sources. The counties/parishes with the greatest volume of oil discharged from industrial point sources include Jefferson, Harris, and Brazoria Counties in Texas, and Calcasieu, St. Charles, and Ascension Parishes in Louisiana (USDC, NOAA, 1985).

Historically, the Nation's rivers, estuaries, and coastal waters have received municipal waste discharges since collection and treatment of domestic wastes was initiated. Prior to the 1970's, ocean disposal was largely unregulated, and adverse impacts on human health and the environment were observed. The principal hazards to human health from sewage waste disposal are associated with the transmission of human pathogens and the ingestion of seafoods contaminated with toxic metals and synthetic organic compounds. Food poisoning, dysentery, and transmission of a variety of human and animal parasites are commonly associated with the discharge of untreated sewage waste. Other adverse impacts are the loss of recreational and commercial resources where beaches or wetlands are fouled with floating waste materials or are closed to fishing and shellfishing because of sewage contamination.

Nonpoint source pollution is among the most challenging of water pollution problems. In contrast to the important progress made in controlling industrial point source discharges and in upgrading municipal sewage treatment facilities, progress with nonpoint sources is negligible (CEQ, 1980). The distinction between point and nonpoint sources of water pollution is not always clear. Point sources generally discharge into surface waters through a discrete pipe, outfall, or ditch, and nonpoint sources generally discharge in a more diffuse way, for example, land runoff. Nonpoint source pollution is primarily the result of precipitation falling and moving over and through land and into surface water bodies. In some cases nonpoint source pollution is the result of human practices, for example, irrigation. All land use activities are potential nonpoint sources of pollution. Nonpoint sources of pollution are classified as urban and non-urban runoff. Urban runoff occurs in areas of relatively high population density that are largely impervious to water because of the large area covered by roads, sidewalks, parking lots, and buildings. Urban stormwater runoff in American coastal counties is approximately 5.3 billion gallons per day. Some 40 million lbs of BOD and 30 million lbs of petroleum hydrocarbons are discharged into the Gulf from urban runoff each year. Orleans Parish in Louisiana has the highest rate of runoff per mi^2 in the region, while Harris County in Texas has the next highest rate (USDC, NOAA, 1985). Non-urban runoff occurs in all land areas other than urban, such as agricultural lands, animal feedlots, pasture land, and forest land. Non-urban areas are more previous than urban areas and absorb a higher percentage of precipitation into the soil. Stormwater runoff from urban and nonurban sources discharge over 40 million lbs/yr of phosphorous directly into surface waters in coastal counties. About 90% of this is associated with sediment losses from agricultural cropland. Coastal counties with the greatest direct discharges from nonpoint sources include Nueces, Victoria, and Jackson Counties in Texas, and Acadia, Vermilion, and Lafourche Parishes in Louisiana (USDC, NOAA, 1985). The effects of nonpoint sources on water quality can be significant, depending on the annual hydrologic cycle and the types of land uses within a region. Estuaries and adjoining coastal areas may be particularly affected. Nearly the entire United States is drained by river systems that eventually discharge into coastal waters. Depending on the pollutants and the characteristics of the river system they enter, various amounts of nonpoint source pollutants are ultimately discharged into coastal waters. Water pollution from nonpoint sources is estimated to affect about 90% of the drainage basins in the United States (U.S. Environmental Protection Agency, 1978). Pollution discharges from nonpoint sources greatly exceed the discharges from point sources. In fact, it has been concluded (U.S. Comptroller General, 1977) that national water quality goals cannot be achieved without some control of nonpoint source pollution.

f. Natural Events and Processes

(1) Natural Catastrophies

Several kinds of major natural processes create particular problems in the coastal zone. These include: hurricanes, which, through high and intense flood surges, may breach barrier islands and dunes, flooding low-lying coastal areas; shoreline erosion under normal and storm conditions; inland flooding along floodplains; and surface faulting and land subsidence.

(2) Natural Oil and Gas Seepage

Historical and contemporary data indicate that hydrocarbon seepage has been, and is, occurring in the Gulf of Mexico and elsewhere in the petroleum provinces of the world. It has proven difficult to pinpoint oil seeps in the deeper water areas of the Gulf, although many areas having anomalous concentrations of hydrocarbons in the water column are recorded on subbottom profiler records. They have also been detected and analyzed with chemical "sniffers." Some of these seeps occur at a considerable distance from commercial production. See Sections III.A.1.d. and III.B.2. for more detail on natural oil and gas seepage and associated biological communities.

(3) Submergence of Coastal Wetlands

The submergence of coastal wetlands in the Gulf of Mexico region contributes to a loss of 50 square miles of land per year in coastal Louisiana. If submergence occurs faster than the rate at which sedimentation and peat formation can build the marsh surface upward, marsh survival is threatened by the waterlogging and ultimate flooding of the marsh. The submergence rate that is critical for the survival of Louisiana marshes has not been determined.

The observed submergence rate in Louisiana has two components: the rate of rise of eustatic sea level and the rate at which the land itself is subsiding beneath the sea. During this century, the eustatic rate of sea level along the

Louisiana coast has been relatively constant at 2.3 mm/yr (23 cm/century), although the rate has varied from a sea level decrease of 3 mm/yr to a maximum increase of 10 mm/yr over decade long periods (Turner and Cahoon, 1988). Depending on local geologic conditions, the subsidence rate varies across coastal louisiana from 3 to 10 mm/yr. The primary natural processes responsible for land subsidence include geosynclinal downwarping, compaction, dewatering, and the horizontal flow of recent sediments. Anthropogenic factors, such as fluid withdrawals from oil and gas reservoirs, appear to have only a localized influence on subsidence, amounting to a much as 80 cm of total subsidence directly above the reservoirs. In coastal Louisiana the total area of wetlands with a subsidence potential related to fluid withdrawals greater than 10 cm is about 400 km^2 (Turner and Cahoon, 1988).

3. Impact Producing Factors Related to Routine Offshore and Onshore Support Activities and Generic Impacts

a. Effluent Discharges

(1) Treated Sanitary and Domestic Wastes

The description of sanitary and domestic wastes is hereby incorporated by reference from Final EIS 113/115/116 (USDI, MMS, 1987b, page IV-34). Wastewater resulting from offshore activities include deck drainage, solid wastes (i.e., sanitary and domestic wastes), cooling water, and desalinization unit discharges. Deck drainage is all waste resulting from platform washing, deck washings, tank cleaning operations, and runoff from curbs and gutters, including drip pans and work areas. Sanitary wastes are wastes from toilets, and domestic wastes are materials discharged from sinks, showers, laundries, and galleys. Cooling water is defined by USEPA as "noncontact" water used for cooling machinery, and desalinization discharges are those wastes resulting from the creation of freshwater from seawater. These discharges are regulated by USEPA through the NPDES.

The volume and concentration of sanitary wastes will vary widely with time, occupancy, platform characteristics, and operation situation. Toilets are usually flushed with brackish water or seawater in offshore operations. Due to the compact nature of these facilities, the wastes have less dilution water than common municipal wastes and result in greater waste concentrations. Any impacts on the water quality of receiving waters of discharges meeting USEPA requirements will be minimal and may be expected to be confined to an area within a few meters of the discharge site.

(2) Treated Drilling Muds and Cuttings

The discharges made in drilling OCS oil and gas wells have historically been the subject of research and public debate with regard to their potential effects on the marine environment. The description of drilling fluids and cuttings is hereby incorporated by reference from Final EIS 118/122 (USDI, MMS, 1988c, pages IV-22 through IV-24), much of which was taken from the National Academy of Sciences (1983) and the Final Regional EIS (USDI, MMS, 1983a). The following is a brief discussion of that material.

Drilling fluids are required in rotary drilling for oil and gas exploration and development to remove cuttings from beneath the bit, to control well pressure, to cool and lubricate the drill string, and to seal the well. For detailed descriptions of the use of muds, see Appendix E of Final EIS 65 and Offshore Operators Committee (1976). There are no alternatives to using drilling fluids in this rotary drilling. Although drilling fluids are recirculated during drilling and sometimes can be held and reused in drilling multiple production wells, they must be eventually disposed of because of their contamination with suspended material, their loss of important properties, or the weight and space limitations on drilling vessels. Cuttings from the drilled formation are removed from the drilling fluid and must also be disposed of. Although drilling discharges can be barged ashore or to other sites at sea for disposal, cost and operational considerations favor onsite disposal by either overboard discharge or shunting through a pipe to some depth. Land disposal is now required for certain drilling fluids (for example, oil-based drilling fluids).

Drilling fluids used on the OCS are composed of bulk constituents and special purpose additives. The principal bulk constituents are water, barite (barium sulfate), clay minerals, chrome lignosulfonate, lignite, and sodium hydroxide. All these constituents are nontoxic to marine organisms at the dilutions reached shortly after discharge. Based on observations of discharges, the plumes are spread out at some depth appropriate to density characteristics and are rapidly dispersed by the turbulent diffusion characteristics of the ocean. Horizontal turbulent diffusion results in dilution of the plumes by a factor of 10,000 or more within an hour of release and an even greater dilution of suspended components because of settling (Brandsma and Sauer, 1983). Several common drilling-fluid additives, including biocides and diesel fuel (No. 2 fuel oil), are much more toxic to marine organisms than the bulk constituents.

Oil-based muds may not be discharged. Muds to which diesel has been added generally may not be discharged. Where oil other than diesel is added to the mud system, it may be discharged as long as there is no visible sheen on the receiving waters and the mud meets the toxicity limitation imposed by USEPA in the NPDES General Permit.

More than 96% of the whole drilling fluids tested in short-term experiments (from 44 to 144 hours) have LC_{50} values greater than 1,000 ppm (which are achieved in offshore oil and gas drilling activities only within a few meters of the discharge point) and are classified as "slightly toxic" or practically "nontoxic" by the IMCO et al. (1969) characterization of toxicity. More than 98% of the tests that have used the suspended particulate phase of drilling fluids found their LC_{50} values greater than 10,000 ppm (in the range of "practically nontoxic"). This distribution of toxicities, representing over 70 drilling fluids and more than 60 species of marine organisms, indicates that most water-based drilling fluids are relatively nontoxic (NAS, 1983).

The National Academy of Sciences (NAS, 1983) made a comprehensive study of the fate and effects of drilling fluids in the marine environment. Because of the authoritative nature of the NAS review, the conclusions of that report were extensively summarized in Section IV.D.1.a.(2) of Final EIS 94/98/102 (USDI, MMS, 1983d). In brief, the report concluded:

> This review of existing information on the fates and effects of drilling fluids and cuttings on the OCS shows that the effects of individual discharges are quite limited in extent and are confined mainly to the benthic environment. These results suggest that the environmental risk of exploratory drilling discharges to most OCS communities are small. Discharges from oil and gas field development drilling introduce greater quantities of material into the marine environment over longer periods of time. Results of field studies suggest that the accumulation of materials from these longer-term inputs is less than additive and therefore the effects of exploratory drilling provide a reasonable model for projecting the effects of development drilling. Uncertainties regarding effects still exist for low energy depositional environments which experience large inputs of drilling discharges over long periods of time.

Based on the NAS findings, MMS has concluded that drilling fluids used on the OCS are not likely to cause any significant ecological damage beyond 1,000 m from the discharge point either in the short-term or the long-term. At most depths typical of the continental shelf, the majority of discharged fluids and cuttings are initially deposited on the seabed within 1,000 m of the discharge point. This material may persist as initially deposited or may undergo rapid or prolonged dispersion, depending on the energy of the bottom boundary layer. Effects on benthos have been observed in the field under low to moderate energy regimes within 1,000 m of the discharge point.

This view was reiterated at a "Mobile Bay Area Drilling Fluids Transport Workshop" held on December 6-8, 1983. The Biological Resources subgroup concluded that:

> Toxicity does not seem to be a problem at the concentrations of material found at distances greater than 200-500 m from the discharge point, and certainly not at distances greater than 1,000 m. Most of the toxicity seems to be due to the presence of 3%-6% diesel oil in the discharges. Eliminating the use of diesel may reduce toxicity to insignificant levels.

In addition to toxic effects, the discharges, particularly the cuttings, form a low mound on the bottom beneath the discharge. Approximately 511-961 yds^3 of cuttings are disposed of during the drilling of an exploration well, depending on the depth of the well. Nonmotile plants and animals covered by this mound may be smothered, and to the extent that this mound exhibits different substrate characteristics (such as grain size, organic content, etc.) from the original bottom, the plants and animals which colonize the mound will be different. However, observations on such mounds show that they are colonized and reworked and that after some period of time become indistinguishable from the surrounding bottom (Zingula, 1975). Furthermore, Menzie (1983) points out that it is the physical change of the substrate rather than any toxic effects that causes a change of benthic fauna around drilling rigs.

All the above notwithstanding, the direct discharge of muds and cuttings on small and productive areas such as coral reefs and live bottoms would devastate delicate ecological relationships, and the resulting change in sediment characteristics could prevent recovery of the predrilling condition.

(3) Produced Waters

During production of oil and gas, fossil or connate water located in the permeable sedimentary rock strata may also be brought up to the surface. This water is called produced water, formation water, or oilfield brine. Produced waters are salt solutions containing higher levels of dissolved solids (salinity) than seawater. Salinity of produced water usually ranges between 75 and 225 g/kg compared to seawater at 35 g/kg. In addition, produced waters may contain elevated concentrations of several metals and elemental sulphur and sulfide. Metals that may be present in produced waters in higher concentrations than seawater include barium, beryllium, cadmium, copper, iron, lead, nickel, silver, and zinc. Produced waters generally have little or no dissolved oxygen. The water may contain high concentrations of organic compounds, particularly dissolved and dispersed hydrocarbons, due to the water being intermingled with petroleum. Soluble organic compounds, with concentrations generally greater than several hundred parts per million, are poorly characterized, but include phenols and organic acids (Boesch et al., 1988). Current USEPA regulations restrict petroleum concentrations (oil and grease) in any produced water effluent to a daily maximum of 72 parts per million. Environmentally high concentrations of naturally-occurring radionuclides, primarily in the form of radium (Ra-226 and Ra-228), are found to exist in Gulf Coast oil field production waters.

Produced water may either be reinjected into the formation or treated to remove dispersed oil and then discharged to the surface waters. Much of the water produced in oil and gas operations on the OCS are discharged directly from offshore production platforms into surrounding waters, and are regulated by the USEPA, NPDES System (Section I). Some is piped ashore first and discharged into nearshore or estuarine waters or injected into the ground. Final EIS 118/122 (USDI, MMS, 1988b) presents a more detailed discussion of produced water characteristics. A recently completed study conducted for MMS (Boesch et al., 1988) provides updated figures on quantities of produced waters discharged. These estimates are 1.5-2 times greater than amounts determined by Gianessi and Arnold (1988) that were described in Final EIS 118/122. Statistics produced from this study determined that 38% of the produced water generated in the OCS are piped ashore for separation and disposal in Lousiana coastal waters. The MMS assumes that all produced waters discharged into Louisiana waters are generated in the CPA. The study also determined that no OCS-produced water is discharged into Texas coastal waters. Furthermore, approximately 23% of the produced waters discharged into Louisiana waters comes from OCS operations. The table below is taken from Boesch et al., 1988:

Estimates of Existing Produced Water Discharges (bbls/day)

	OCS Offshore Disposal	OCS Coastal Disposal	Louisiana (within State)	Texas (within State)	Total
Volume	736,928	443,072	1,516,662	735,854	3,432,516
Percentage	21%	13%	45%	21%	

Amounts projected to be discharged either onshore or offshore due to Sales 123 and 125, due to not yet produced oil and gas from past sales, and due to future sales are presented in Tables IV-1 and IV-2. These numbers are determined by using conversion factors described in USEPA's (1987) report to Congress. Factors used are 8.42 bbls of water for every barrel of oil and/or condensate produced, and 17.7 bbls of water for every million cubic feet of gas produced.

There have been a number of studies investigating the effects of produced waters on marine and coastal ecosystems. Dilution of produced water in offshore waters is very rapid. In the Buccaneer Oil Field study (Middleditch, 1981), total hydrocarbon concentrations in the water column rarely exceeded 30 ug/liter in the vicinity of the produced water discharge, even though total petroleum hydrocarbon concentrations in the produced waters were 20 mg/liter and the major source of hydrocarbons in the area was associated with the discharge of produced brines. In Trinity Bay, Texas, total resolved hydrocarbons in produced waters were diluted by 2400-fold within 15 m down current from the discharge source (Armstrong et al., 1979). Major biological effects to biota is rarely documented. Harper (1986) concluded that diffusion and dispersion limit biological effects to within a few meters of the discharge point in offshore waters. Armstrong et al., (1979), examining a shallow estuarine system, found a zone of severely depressed benthic fauna out to about 250-350 m from the discharge point. A recently completed study conducted for MMS (Boesch et al., 1988) examined three sites in coastal Louisiana which were receiving OCS-generated produced waters. The results found substantial petroleum hydrocarbon contamination of the sediments near the discharge sites at all three locations. Polynuclear aromatic hydrocarbons in the sediments exceeded background levels by over an order of magnitude. Contaminated sediments extended several hundred meters to over 1 km from the discharge point. This large areal extent of contamination not seen in previous studies was explained to be due to the poor dispersion characteristics of the receiving waters and to the larger than previously examined volumes of produced waters. Furthermore, marcrobenthic organisms were reduced in density and diversity in the contaminated sediments and filter feeding bivalves in the proximity of the discharge sites had accumulated petroleum hydrocarbons in their tissues.

A new MMS contracted study examining the impacts of produced waters in coastal areas will begin field work in 1988. This study will continue with the program design of the earlier referenced study but will elucidate, in finer scale, more details of the determined impacts. More sampling will occur around the previous sites as well as new sites. At least one abandoned site will be studied. Sampling will include measurements of constituents along gradients extending from the sites, analysis of hydrogen sulfide and radionuclide concentrations, and current measurements to aid in characterization of plume dispersion. Overflights will be used to examine broader scale impacts.

(4) Onshore Nonpoint and Point Source Pollution

Onshore support facilities supporting OCS activities in the Gulf can impact surrounding water quality by both point and nonpoint pollution discharges. Point source discharges from onshore facilities are subject to effluent limitation and compliance requirements established in Federal and State discharge permitting programs. A description of the onshore support facilities is presented in Section IV.A.1.d.

Construction of these onshore support bases and ancilliary access facilities contribute to onshore water quality degradation. Navigation channels and other waterbodies may be dredged or their morphology altered; existing waterbodies may be diked, leveed, or impounded; and piers, bulkheads, and/or beach stabilization actions may be undertaken. To construct the support facility, the land must be cleared, soil compacted, and roadways and bridges built; sewage and stormwater systems installed; and groundwater or adjoining waterbodies accessed for sanitary and domestic water use. Industrial facilities usually require wastewater and cooling water systems. Construction activities and all hydromodification actions would result in some runoff and other nonpoint source pollution to the surrounding water bodies. The facility's presence along with access routes alters the natural hydrology of the area. The volume and rate of stormwater runoff increases, saltwater intrusion may occur, the existing vegetation is modified, and greater erosion around the facility may take place.

Besides water quality problems resulting from the physical presence of the onshore facility, many of the support bases contribute a number of point source discharges to the surrounding waterbodies. Service bases and marine terminals discharge hydrocarbons in their bilge and ballast waters or through accidental oil spillage, and release heavy metals and contaminated sludge. Pipecoating yards, platform construction facilities, and repair and maintenance yards contaminate surrounding waters by releasing thermal effluents, antifouling chemicals, heavy metals, and a variety of process waters, as well as solid waste such as packaging materials, metal scraps, and other debri. Gas processing plants and refineries discharge a number of types of wastewater effluents, including cooling water, domestic wastewater, and process water. These waters may be contaminated with dissolved hydrocarbons, sulfuric acid, chromium, zinc, phosphates, alkaline substances, and suspended solids. Of the water discharged from processing facilities, process water is the most contaminated. Contamination of the water occurs during crude oil desalting, steam distillation, steam stripping, etc. It is toxic due to its anaerobic and highly reduced character and the presence of numerous heavy metals, sulfides, and ammonia. For a further discussion of the possible effects of these discharges on the receiving water bodies and biota, see Final EIS 113/115/116 (USDI, MMS, 1987b).

b. Air Emissions

The major IPF's on air quality from OCS-related activity are due to combustion, evaporation, or venting of hydrocarbons. Commonly used equipment that generates air emissions are diesel-powered generators and pumps. In the offshore environment, potential impact-producing activity includes catastrophic events (blowouts with fire or the release of sour gas) and operational emissions. In the onshore environment, potential impact-producing activity includes the operation of oil refineries, gas processing plants, and vessel offloading.

Offshore, effects of an immediate nature are those caused by catastrophic events such as blowouts with fire or the release of free hydrogen sulfide (sour) gas. Air emissions from these sources are of a nonroutine nature and can be expected to last for a short period. However, due to the release of large nitrogen oxides (NO_x), sulphur oxides (SO_x), carbon monoxide (CO), total suspended particulates (TSP), volatile organic compounds (VOC) (in the event of blowout with fire), and hydrogen sulfide gas (H_2S) (from blowout-no-fire-in sour gas prone areas), effects that are of an immediate nature are likely to occur and in some instances could result in serious health hazards. A factor influencing the effects of such events is the volume released, the rate of release, and the distance to shore. Events could occur on the OCS from a minimum of 3 miles to as far as 200 miles from shore.

Blowouts, also being nonroutine events that may persist for many days or weeks, emit substantial levels of NO_x, SO_x, CO, and TSP when associated with fire. These emissions can be considered a point source and have the potential of dispersing over land areas under certain circumstances; this, of course, depends on the location of the event and wind conditions. Emissions from these sources farther offshore have little potential of degrading onshore air quality; however, if such an event were to persist nearshore for some time, it may degrade onshore air quality to an unknown level. If these events affect any nonattainment area or PSD Class I area, the consequences would be more serious than if it occurred near attainment areas.

An unflared blowout in an area where sour gas exists could present serious health hazards within a radius of approximately three miles from the source. Concentrations of H_2S in excess of 400 ppm for a 30-minute or less exposure are considered dangerous to humans and 700 ppm is estimated to be fatal to humans. Should an event occur, H_2S content of gas, local wind conditions, and other factors would control the impacts of the event. Uncontrolled emissions of this nature are unlikely to cause hazards onshore if the source is farther than approximately 4-5 miles offshore.

Operational emissions due to offshore and onshore OCS-related activity may create effects of a more long-term nature. Air pollutants associated with OCS activities include NO_x, CO, SO_x, TSP, and VOC/hydrocarbon compounds. Ozone (O_3) is not emitted directly by any source; ozone is formed in a photochemical reaction in the atmosphere involving VOC and NO_x.

NO_x consists of nitrix oxide (NO) and nitrogen dioxide (NO_2). NO_x is formed through the combination of oxygen and nitrogen in the air during the combustion process. The rate of formation increases as combustion temperature increases. Most emissions are initially in the form of NO which will slowly oxidize in the atmosphere to form NO_2.

CO is formed by incomplete combustion. Highest concentrations of CO are associated with automotive vehicular operation in densely populated urban centers.

SO_x is formed in the combustion of fuels containing sulphur. SO_x in the atmosphere slowly converts to sulfate particles, which in the presence of atmospheric vapor (clouds) may produce sulfuric acid mist. Entrainment of sulfate particles into storm clouds may contribute to reduced pH levels in precipitation. If the pH reduction is significant, acid rain will result.

TSP emissions associated with combustion consist of small particles less than 10 microns in diameter. Particulates of this size range can cause respiratory illness and tend to reduce visibility in the atmosphere if in sufficient concentration.

O_3 may be formed when NO_2 breaks down under the influence of sunlight producing NO and atomic oxygen (O), which then combines with diatomic oxygen (O_2) to O_3. The atomic oxygen (O) may combine with any of various hydrocarbon compounds (VOC) to form gaseous and particulate compounds that, if in sufficent concentration, may result in physiological irritation and reduced visibility.

Operational emissions from offshore activity and onshore activities typically emit constant levels of VOC, NO_x, CO, SO_x, and TSP. The levels of these emissions and the effect of these emissions on ambient air quality are of concern. Specifically, if normal operational emissions from these sources degrade the air quality of onshore areas such that the NAAQS are exceeded, a threat may exist to the health of individuals and to the welfare of the natural environment of the affected area. Many conditions define the magnitude of this threat, such as the number of pollutants present, the concentration (density) of the pollutant(s), and meteorological conditions by area over time.

c. Noise Emissions

Noise emissions resulting from OCS development are associated with the construction and operation of offshore structures, drilling rigs, seismic geophysical surveying, petroleum transfer facilities, onshore processing plants, pump stations, aircraft, and vessels.

No onshore noise impact is expected from normal operations of OCS structures since even under low background noise conditions they would not be audible from shore. Onshore noise levels could be slightly increased by vessel, vehicle, and helicopter traffic; however, these increases are generally expected to be small. Most of the onshore processing and support facilities would necessarily be located in industrially zoned areas where noise would have a minimal impact. If adverse noise impacts could result, mitigation measures such as sound barriers (i.e., earthen berms, block walls, etc.) and mufflers could be utilized. The site-specific noise impacts of these developments will be considered in future environmental documents when detailed development plans are known.

Drilling and production structure noises are generally similar to those used for shore-based operations. Compressors and diesel engines are usually the loudest equipment on a typical structure, emitting about 90 db at a distance of 15 m (50 ft). By comparison, a diesel truck under full load also emits about 90 db at 15 m. Although other sounds such as the banging of pipes may be more intense, they are of short duration. The effect of harmful levels of noise emissions to structure personnel can be mitigated by standard safety practices and noise attenuation devices.

Acoustic stimuli may also modify animal behavior and physiology, depending on the species studied, characteristics of the stimuli (i.e., amplitude, frequency, pulsed, or nonpulsed), season, ambient noise, previous exposure of the animal, physiological or reproductive state of the animal, and other factors. Possible adverse effects from loud sounds include auditory discomfort due to loudness/pressure changes, possible hearing loss, the potential masking of sounds such as might be used in intraspecies communications, and behavioral responses resulting in avoidance of an area. Human activities associated with OCS exploration and development, especially air and vessel traffic near nesting waterfowl and seabirds, could reduce productivity of some species and may cause abandonment of important nesting, feeding, and staging areas. The responses of birds to human disturbances are highly variable. These responses depend on the species; the physiological or reproductive state of the birds; distance from the disturbance, type, intensity, and duration of the disturbance; and many other factors. Waterfowl nesting on deltas and islands may also be disturbed by aircraft and vessel traffic, and some disturbance of molting and staging birds is likely to occur. However, effects studies by Ward and Sharp (1974) and Gollop et al. (1974) indicate that long-term displacement or abandonment of important molting and feeding areas due to occasional aircraft disturbance is unlikely.

The subsea noise could have an adverse effect on fish, sea turtles, marine mammals, and Naval activities. Gales (1982) points out that in light seas the subsea surface noise propagated by aircraft and vessel traffic, and human presence associated with OCS-related oil/gas activities could adversely affect marine mammals that occupy overwintering and breeding areas in or near sale areas. Short-term responses of whales to acoustical disturbances that have been demonstrated include flight and startle response; vacating of an area; deflecting of migration routes; and changes in swimming, diving, and respiration characteristics. The degree of responses ranged from those so subtle that statistical analysis was necessary (Malme et al., 1984) to determine whether or not a change had occurred to total abandonment of an area for several years and return only when historic ambient noise levels were restored. There are many areas where industrial noise had been ongoing for several years; whales have continued to utilize these areas, to some degree, during their migration cycle. If acoustical disturbances persist in critical areas, long-term effects may result. Long-term effects may include permanent abandonment of some habitats, physical damage to the whale's auditory system, and changes in some portion or timing of their migratory cycle. Areas where long-term effects may be most likely to develop are in habitats where ambient noise levels do not presently include high levels of industrial noises (e.g., summer feeding areas and overwintering areas) or where many whales use a small area intensively. Habituation may be possible if increases in industrial noise levels proceed at a very slow rate (20-40 years).

d. Physical Presence of Drilling Rigs, Platforms, Boats, and Barges

The exploration, development, and production of OCS resources consist of many phases of activity including pre- and postlease geophysical and geological surveys with medium to small size vessels, the placement of exploratory rigs, support from local bases utilizing crew and work boats, the placement of platforms for long-term use, the use of barges and work boats in support of production activities, and transmission by pipeline or barge of production to shore. All these activities affect their surroundings merely due to their presence in the area.

An increase in ship or boat traffic in an area may or may not have an impact on the area depending on existing conditions. It is possible, however, that any increase in vessel traffic could pose additional transportation safety hazards in an area heavily traveled or particularly difficult to navigate. If existing port and supply facilities are to be used, and this is the assumption regarding activities resulting from these sales, increased usage may affect their adequacy to meet all commercial needs. Increased vessel traffic could increase the potential for collision with sea turtles and marine mammals, particularly in port areas and shallow navigation channels.

The presence of offshore rigs and platforms occasionally conflicts with commercial and sport fishing interest for space. However, this is often offset by the fish-attracting capabilities of the structures. Commercial trawling would be most affected by the presence of offshore structures. If a rig is placed in productive fishing grounds, commercial fishermen would assume the burden of safe navigation around these obstacles without entangling their gear.

All platforms and rigs are obstacles to local navigation. It is fortunate, however, that these structures are quite visible to mariners due to their size and lighting.

At a distance of 3 miles, platforms and rigs are visible on nearshore Federal leases, although on many days, atmospheric conditions (fog, mist, or low lying clouds) make all but the closest rigs invisible to the naked eye. Between 12 and 20 miles offshore, visual distractions can be seen from the beach only under ideal atmospheric conditions. Even then, little is visible except at night, when only the lights on top of the rigs are visible. Beyond 20 miles, nothing can be seen from sea level because of the curvature of the earth (USDI, MMS, 1983b).

Studies completed by Dornbusch and Company et al. (1987) to determine the degree of association between OCS visual distractions and beach attendance in California (and thus tourism and recreation) indicated ambiguous results. Therefore, they declined to include this variable in their model, which produces detailed quantitative impact results.

Rig and platform emplacement will result in disruption and suspension of sediments only in the immediate vicinity of the site. Displaced material or the physical presence of the rig or platform can smother burrowing and attached benthos. Increased turbidity resulting from rig and platform emplacement can temporarily clog the respiratory organs of many marine organisms and the filter-feeding mechanisms of numerous others. This increased turbidity is a short-term phenomenon and generally is not significant beyond a few hundred meters from the site of the rig, platform, or associated anchors.

e. Pipeline Construction

There is a detailed discussion of pipeline construction as an impact producing factor in Section IV.A.3.e. of Final EIS 118/122. That section is hereby incorporated by reference and the following is an update of that information.

Federal offshore pipeline construction has been occurring in the Gulf of Mexico since 1951. As of December 1987, the cumulative number of miles of OCS pipelines is 17,604 miles (Tables IV-1 and IV-2). Offshore and onshore oil and gas pipelines are considered impact-producing factors of special concern in the marine and coastal environments on the basis of potential space/use conflicts, displacement of bottom sediments, accidental oil spills, and other environmental perturbations. The Regional Environmental Assessment of Pipeline Activities, covering the northern Gulf of Mexico region and the contiguous coastal zone, discusses regulatory procedures pertaining to pipeline installation associated with the Federal oil and gas program, describes the affected offshore and onshore environments, and discusses the environmental impacts of the construction of pipelines on the OCS and nearshore region of the Gulf of Mexico (USDI, MMS, 1983c).

The emplacement of a pipeline, by whatever technique, will always disturb a certain amount of substrate. A recently completed MMS study (Turner and Cahoon, 1988) of the impacts of OCS-related activities on coastal wetlands has determined that the direct impacts of pipeline installations has been 10 acres of impact on adjacent wetlands per mile of pipeline. The direct impacts of these pipeline projects include the conversion of wetlands to open water and spoil bank, and the subsequent widening of the canal as a result of bank erosion. Also, operation of heavy equipment in coastal marshes and swamps adjacent to canals can be very destructive to these habitat types for many years.

Pipeline installations also produce indirect impacts. The spoil banks that line pipeline canals can interfere with natural drainage from the marshes and increase the amount of waterlogging that occurs in marsh soils. Drainage is particularly impaired where two or more canals intersect and impound or semi-impound wetland areas. Poor drainage impairs the growth of wetland vegetation and encourages the conversion of wetland areas to open water. Another potential indirect impact of pipeline canals is to encourage saltwater intrusion. Linear canals that connect different salinity environments can encourage the movement of saline water into fresher areas. If canals are backfilled, however, the penetration of saltwater is prevented or inhibited. On the other hand, if the canals are left open and spoil banks remain beside the canal, the spoil banks will inhibit or prevent the movement of salt water from the canal into the marsh. In the MMS-funded wetlands study (Turner and Cahoon, 1988), an investigation of the relationship between salinities in a canal and in adjacent marshes showed no to little correlation. Apparently, high salinity water from a canal or a bayou is introduced into a marsh periodically as a result of overbank flooding during high water stages and not on a continual basis through subsurface seepage. Under some circumstances, dredge spoil banks may actually operate to inhibit the movement of saltwater from the canal into the marsh. The spoil banks, however, may also operate to retain high salinity water within the marsh after the marsh surface has been inundated. Based on current available information, therefore, it is not possible to make an unequivocal statement about the relationship between pipeline canals and saltwater intrusion in wetlands.

In general, in coastal wetlands both direct and indirect impacts of pipeline canals are reduced when the canal is backfilled immediately after the pipeline is installed. In a marsh habitat, if a pipeline is covered with spoil from the trench, revegetation by marsh species will occur and impacts will be minimized. The absence of spoil banks restores the natural drainage off the marsh surface, and the absence of an open canal eliminates any question of potential saltwater intrusion. Some marsh users, however, do value open canals for fishing and for navigating through wetland areas. In recognition, however, of the beneficial aspects of canal backfilling, the State of Louisiana has required all pipeline canals to be backfilled for the past several years.

Emplacement of pipelines in shallow bays, estuaries, nearshore areas, and in soft-bottom offshore areas will usually suspend much bottom sediment and organic matter, and with it, possibly nutrients, toxic heavy metals, and pesticides. These substances are then often re-introduced into the food chain. The attendant increase in turbidity is, although temporary, also detrimental to fish larvae and aquatic invertebrates because of clogging of gills and feeding structures. Displaced material from pipeline trenches will smother and/or displace sessile benthos. Recolonization of the disturbed areas depends on the types of organisms present and the kinds of substrates involved.

f. Dredging Activities

Dredging of new channels and maintenance dredging of existing channels is required to provide safe and efficient navigation conditions for marine transportation. Channel dredging generates significant amounts of dredged material consisting of the sediment and water mixture excavated from areas dredged. On the basis of volume, dredging is the largest single source of material that is ocean dumped. During 1984, more than 26 million cubic yards of dredged material were deposited in the Gulf of Mexico (U.S. Dept. of the Army, Corps of Engineers, 1985). Compared with other materials that are disposed of in the ocean, most of the dredged material excavated in the United States is relatively innocuous, in many instances containing no harmful pollutants or only trace levels of contaminants. In these cases, the primary concern associated with disposal of such materials centers around the direct physical effects of disposal. These physical effects include burial of organisms, increased levels of suspended sediments, and accretion of disposed material. However, dredged material taken from highly polluted areas is contaminated with harmful chemical constituents such as heavy metals, synthetic organics, and oil and grease. Open-ocean disposal of these polluted materials carries the threat of acute or chronic toxic effects on marine organisms and potential contamination of human food resources. Much research has been conducted to describe the effects of dredged material disposal in the marine environment and evaluate disposal options that may be preferable to ocean dumping.

Dredging operations for channel construction and maintenance, pipeline emplacement, access to support facilities, and siting for onshore facilities in estuaries have environmental effects that range from transitory to long term. Dredging activities release sedimentary materials into the water column, which result in transient increased turbidity in the surrounding waters. This turbidity leads to reduced light penetration and possible clogging of filtering systems of benthic organisms. Coral, filter feeders such as oysters, and barnacles are particularly vulnerable to the effects of siltation resulting from dredging. Dredged materials may also contain chemicals that can include toxic organics, heavy metals, high levels of nutrients, and hydrocarbon compounds and that can affect flora and fauna contacted by the turbidity plume. Removal of the sediments alters the benthic interface between water and water bottom and may remove substantial burrowing and sessile bottom organisms. The dredged channel topography may result in salt water intrusion into less saline marsh; movement of chemicals into previously uncontaminated areas; altered tidal exchange, mixing and circulation; or accelerated drainage processes. The dredged area may create an environment highly susceptible to recurrent low dissolved oxygen levels or may create a deep water area which either exposes or collects contaminates or provides refuge for fish.

The deposition of the dredged material or surrounding spoil banks can affect the environment by spoil bank interference with circulation in marsh areas; reduction of nutrient outflow from marshes and swamps; redistribution of nutrients, organic contaminants, and heavy metals possibly contained in spoils; coverage of plants, eggs, larvae, and larger organisms (covering high biomass substrates with low biomass substrates); and deposition of unconsolidated sediments incapable of supporting benthic organisms.

In a recently completed MMS Study examining causes of wetland loss, it was estimated that dredged canals and their associated spoils account for loss of between 87,450 - 169,641 hectares of wetland during the period between 1955 to 1978 in Louisiana. This represented between 30 to 59% of the wetland loss problem in Louisiana. Of this, dredge and spoil operations in support of OCS activities accounted for 8%-17% of the total loss (Boesch et al., 1988). Loss figures include both direct land loss from dredging and spoil placement and indirect land losses, such as loss caused hydrologic changes. The report cautions, however, that these numbers are based on the interpretation of limited data and should be used with caution to indicate only the relative magnitudes of possible impacts.

g. Seismic Operations

Direct impact-producing factors that are associated with seismic operations are subsurface impulses and the presence of vessel and associated trailing gear. Seismic operations involve the accurate measurement of the travel time required for an artificially-generated seismic (acoustic) wave to travel into the subsurface and return after being reflected or refracted by either unconsolidated sediments or rock layers below the seafloor. Sound sources for seismic operations include electric sparkers, air guns, sleeve exploders, electromechanical devices, and, rarely, explosives. A frame with an array of air guns is most commonly used.

Sparkers create an acoustic pulse by generating a powerful electric spark between submerged electrodes. Air guns explosively release a charge of high-pressure air into the water. Sleeve exploders ignite a bubble of gas (such as propane) in a manifold (sleeve). High-resolution seismic operations frequently generate their sound pulse by electrically causing two confined metal plates to separate rapidly.

Seismic operations have caused concern between commercial fishing and environmental groups. These concerns are that the surveys are lethal or damaging to fish eggs and larvae, disturbing to fish and other marine life, and may also be destructive to commercial fishing gear. Additionally, it may be that seismic surveys conflict physically and spatially with commercial fishing. It is obvious that two users of the same space are sometimes going to come into conflict.

Whales' reactions to seismic activities vary between an immediate response (e.g., flight and startle response) to seemingly no reaction, depending on the proximity of the seismic vessel (Malme et al., 1984). Behaviors in whales are measured by changes in dive duration, surface duration, number of blows per surfacing, travel direction and speed, calling rate, respiration rate, and other dive characteristics.

Shock waves associated with seismic air guns would not immediately be harmful to marine animals (Geraci and St. Aubin, 1980), although noise may affect behavior. Other information (Dome Petroleum Ltd. et al., 1982) suggests that while seismic and/or vessel noise might temporarily affect hearing, mask vocalizations or sound used to locate prey or predators, or result in temporary displacement, nearby effects on regional populations are likely to be negligible.

For further information on seismic operations and their associated impacts, see *Environmental Assessment for Geological and Geophysical Exploration Activities on the Outer Continental Shelf* (USDI, MMS, 1984e).

h. Trash and Debris

Public and private interests have indicated that debris clearly associated with the petroleum industry (oil drums, large plastic containers and sheeting, computer read-write rings, seismic markers, styrofoam floats, pipe thread protectors, diesel filters, hard hats, and tar balls) is a serious, chronic problem on major recreational beaches in the Western and Central Gulf. Removal, analysis, and disposal of beached 55-gallon drums along South Texas beaches cost the Federal Government upwards of $400,000 in 1985. Over one-half of the 300 drums whose contents were analyzed in 1985 were found to contain hazardous materials, thereby posing potential health hazards to beach users, marine resources, and wildlife. Additional impacts caused by marine debris in the Gulf of Mexico is the entanglement of birds, fish, sea turtles, and marine mammals in plastic rope, straps, or netting and the ingestion of plastic bags, sheeting, 6-pack rings, and styrofoam particles (Centaur Associates, Inc. and Center for Environmental Education, 1986). Others in the Central and Western Gulf have also noted the recurring problem of debris wash-up from offshore petroleum operations affecting beach use, aesthetics, and beach maintenance requirements along the Gulf of Mexico shorefront. A special MMS scoping report on beach litter and presentations at several Gulf of Mexico Information Transfer Meetings (Proceedings . . ., 1985, 1986, and 1987) demonstrated the significance of the beach litter problem Gulfwide and implicated the oil and gas industry as a major contributor in the CPA and WPA. Buoyant debris within the marine environment can also affect vessel operations in the Gulf of Mexico.

i. Anchoring

Anchors from support boats and ships, floating drilling units, and pipeline laying vessels do a great deal of damage to corals. The area actually affected will depend on depth of water, length of chain, size of anchor and chain, wind, and current. Anchor damage includes crushing and breaking of coral heads. Anchoring often destroys a wide swath of sessile organisms when the anchor is dragged or the vessel swings at the anchor causing the anchor chain to drag the seafloor.

Continental Shelf Associates (CSA) documented the damage caused by a single anchoring incident at the East Flower Garden Bank. The vessel involved was a tug with an attached barge. The predominant area of impact was approximately 3 m wide and 61 m long. Beyond this band, CSA observed intermittent impact in a band extending an additional 122 m. Initially, CSA attempted to count the individual coral colonies impacted; however, they abandoned the count after 200 colonies within 61 m. Mechanical damage to the coral colonies occurred with varying degrees of severity. Slight abrasions of the tissue were widespread. A more severe impact was the complete removal of coral tissue. Finally, the most severe damage resulted from the anchor cable that sawed coral heads in half, severed heads from their attachment points, and created deep gouges and fractures. Relatively minor impacts can lead to more severe effects due to the introduction of disease or algal infections into the damaged coral tissues. These infestations can lead to mortality of the entire colony (CSA, 1984).

j. Structure Removal

There is a detailed discussion of structure removal as an impact producing factor in Section IV.A.3.j. of Final EIS 118/122. That section is hereby incorporated by reference and the following is an update of that information.

In the northern Gulf of Mexico there are about 3,628 oil/gas offshore platforms and other structures on the Federal OCS and several thousand in State waters. Oil and gas offshore platforms attract and provide habitats for a variety of marine organisms. Removal of these structures eliminates these habitats and, in the case of exposive removal, could injure or kill these organisms during detonation. Historically about 55-65 of these structures are removed annually from offshore waters. During 1984, 1985, and 1986, there were 59, 69, and 59 structures removed, respectively. In 1987, there were a total of 22 structures removed (9 utilizing explosives and 13 using nonexplosive methods). As of October 1988, 149 structures have been removed (85 were removed using explosives, 41 using nonexplosive methods, and 23 removed using both methods). Lessees are required to remove all structures and underwater obstructions from a lease block within one year after the lease is relinquished or terminated.

Both marine mammals (bottlenose dolphin) and sea turtles have been observed near offshore structures. A discussion of the animals' occurrence across the CPA and WPA and an assessment of the potential impacts of structure removal activities on these animals can be found in a programmatic environmental assessment (USDI, MMS, 1987a). The MMS observers at 17 offshore oil/gas structure removals from November 1986 to June 1988 have sighted 3 sea turtles and 12 bottlenose dolphins. No injuries or mortality of any sea turtles or bottlenose dolphins were observed at any of these structure removals.

Fritts et al. (1983) conducted aerial surveys across a 9,514 square mile area in the Central, Western, and Eastern Gulf of Mexico. Results of these surveys indicate that the bottlenose dolphin is by far the most likely marine mammal to be encountered at a proposed structure removal site.

Studies by Fritts et al. (1983) and Fuller and Tappan (1986), as well as stranding data from the Sea Turtle Stranding and Salvage Network (USDC, NMFS, 1988b), indicate that sea turtles may occur in the vicinity of proposed structure removal sites. Definitive information on the possibility of encountering sea turtles at a removal site during removal operations currently does not exist. The MMS has funded an aerial survey of some OCS oil/gas structures in cooperation with NMFS to collect data pertaining to possible association of sea turtles and offshore oil/gas structures. Since the possibility exists that sea turtles may be taken by explosive structure removal operations, a Summary Evaluation is prepared by MMS to initiate a Section 7 consultation under the Endangered Species Act, as amended, with the NMFS. A Biological Opinion and an Incidental Take Statement (ITS) is prepared by the NMFS. Within the ITS are mitigative measures developed by NMFS to prevent injuries to sea turtles. A copy of a recent NMFS biological opinion pertaining to structure removals is in Appendix B.

B. OIL SPILLS

Accidental discharge of oil can occur during almost any stage of exploration, development, or production on the OCS. Oil spills occur as a result of many causes, i.e., equipment malfunctions, pipeline breaks, human error, severe storms, etc. Although many oil spills are not directly attributable to the oil extraction process, they are indirectly related through the support activities necessary to recovery and transmission of the resource. Of these various potential spill sources, the great majority of accidental discharges have resulted from production activities (NAS, 1985; USDI, MMS, 1986a).

Impacts to sensitive resources from an accidental crude oil spill will depend on such factors as the initial size of the spill; the duration of the spill; whether the spill originated at the seafloor, surface, or at some point in between; the degree of weathering and dispersion that has occurred; and the sensitivity of a resource to the various components of the crude oil. Impacts range from direct effects such as the smothering of organisms and toxic effects to such indirect effects as disruption of a critical food source or interference with the ability to attach to a particular substrate. This range of impacts may occur to a single sensitive resource depending on the specific combination of critical factors present when the spilled crude reaches that resource. Refer to the analyses in Section IV.D. for a discussion of the variety of possible impacts to any specific resource.

The size of an oil spill can vary greatly from less than one barrel to hundreds of thousands of barrels being released over a period of time as a result of a single event. It is currently unknown if there is a direct relationship between the size of a spill and the event responsible for it. Because of this, estimates of the number, volume, location, and impacts resulting from accidental oil spills will be discussed based on spill size rather than source.

The OCS Lands Act requires the Secretary of the Interior to investigate and prepare a public report on each major oil spillage. In accordance with the Act, a major oil spillage is any spillage in one instance of more than 200 bbls of oil during a 30-day period. The MMS has issued regulations (30 CFR 250.41) requiring operators to report all accidents orally to the District Supervisor and to confirm spills greater than one barrel in writing. The report must include the cause, location, volume of spill, and action taken. In the case of spills greater than 50 bbls, the sea state, meteorological conditions, and size and appearance of the slick must also be included in the report.

To support the environmental analyses conducted for this EIS, the breakdown in size categories will be different than those stated above. Spill statistics will be divided into two major categories, large and small, based on the requirements of the Oil Spill Risk Analysis (OSRA). Spills of 1,000 bbls or greater are considered large while all spills less than 1,000 bbls are classified as small. The 1,000 bbl-cutoff was selected primarily for two reasons. First, the smaller spills may occur unnoticed offshore and thus not be included in historic databases. Secondly, the projected large spills will be modeled by the OSRA, which requires as input, spills large enough to travel great distances or remain intact for up to 30 days time.

1. Oil Spill Risk Analysis

The OSRA is a three-step process to assess the potential risk to sensitive environmental resources posed by oil spills. This assessment is a long-term, statistical approach that is intended to estimate both the likelihood of spill occurrence and the probability of contact with the resources over the estimated 34-year lease life. The first step estimates the occurrence of one or more oil spills by comparing historic spills to past OCS production. Next, the trajectory portion of the OSRA model uses surface currents and wind data to calculate seasonal trajectories. These trajectories are then combined with the estimated spill occurrences to project which sensitive resources might be contacted.

a. Historic Large Spill Rates

The spill rates used by OSRA are computed by comparing historic spills of 1,000 bbls or greater to OCS production for the same time period. A reexamination of spill occurrence, performed to incorporate recent historical spills of 1,000 bbls or greater, has just been completed (Anderson and LaBelle, 1988). This analysis produced new rates for platform and pipeline activities and confirmed the tanker spill rates previously used (Lanfear and Amstutz, 1983; Nakassis, 1982). This analysis identified a decline of 40% for platforms and 50% for pipeline activities since the last evaluation in 1983. The spill rates used in the OSRA run to support this EIS are as follows:

	Spill Rates 1,000 bbls or greater/billion bbls produced and transported
Platforms	0.60
Pipelines	0.67
Shuttle Tankering	0.90 (at sea in the Gulf)
Import Tankering	0.45 (at sea in the Gulf)

The import tankering spill rate (at sea in the Gulf) is one-half the worldwide tanker spill rate (at sea) and is based on the assumption that 50% of the spills related to import tankering will occur on the inbound portion of the journey in the Gulf of Mexico study area.

b. Estimated Mean Number of Spills

The mean spill rates shown in Section IV.B.1.a. above are applied to the estimated volumes of oil expected to be produced and transported, according to each scenario, in order to project the appropriate mean number of spills estimated to occur from these scenarios. This spill rate constant is simply multiplied by the volume of oil to estimate the mean number of potential spills. For large spills the volumes are aggregated by platform activities and by pipeline and tanker transportation methods. Table IV-5 presents the estimated mean number of spills and the probability, expressed as percent chance, of one or more large spills to occur. The tankering values presented in this table only represent that portion of the route covered away from the coastal and port areas. For the major Gulf ports accepting tankered crude oil, the following values represent the probable spill occurrence in the nearshore/port area itself.

Table IV-5

Oil Spill Occurrence Probability Estimates for Spills Equal To and Greater Than 1,000 Barrels Resulting Over the Expected Production Life of the Proposed Actions, Total Planning Area, and from Imports of Crude Oil by Tanker into the Study Area

Source*	Volume (BBO)	Mean Number of Spills from Platforms	Mean Number of Spills from Pipelines	Mean Number of Spills from Tankers	Mean Number of Spills (total)	Probability (% chance) of One or More Spills (platforms)	Probability (% chance) of One or More Spills (pipeline)	Probability (% chance) of One or More Spills (tanker)	Probability (% chance) of One or More Spills (total)
Proposed Action									
Base Case									
Western Gulf	(0.10)	0.06	0.03	0.05	0.14	6	3	5	13
Central Gulf	(0.17)	0.10	0.06	0.07	0.23	10	6	7	21
High Case									
Western Gulf	(0.22)	0.13	0.06	0.11	0.30	12	6	10	26
Central Gulf	(0.33)	0.20	0.12	0.14	0.46	18	11	13	37
Total Planning Area									
Western Gulf	(1.53)	0.92	0.54	0.65	2.11	60	42	48	88
Central Gulf	(6.00)	3.60	3.13	1.20	7.93	97	96	70	99+
Eastern Gulf	(0.24)	0.14	0.05	0.14	0.33	13	5	13	28
Tankering of Crude Oil Imports									
All Planning Areas	(75.07)	--	--	33.78	33.78	--	--	99+	99+

*There is an estimated 99% probability of finding hydrocarbons in the Eastern Gulf of Mexico for the proposed actions and future sales and an estimated 97% probability for prior sales.

Source: Hannon et al., 1988.

Tanker Spill Occurrence for Major Ports
Receiving Crude Oil

Port	Base Case (34 years) Mean No.	Base Case (34 years) Prob.	High Case (34 years) Mean No.	High Case (34 years) Prob.	Imports (34 years) Mean No.	Imports (34 years) Prob.
Corpus Christi, TX	--	--	--	--	1.80	0.83
Freeport, TX	--	--	--	--	0.60	0.45
Houston, TX	--	--	0.01	0.01	3.91	0.98
Port Arthur, TX	--	--	--	--	1.80	0.83
Lake Charles, LA	--	--	--	--	1.50	0.78
Miss. River Ports, LA	0.01	0.01	0.03	0.03	1.50	0.78
LOOP	--	--	--	--	2.25	0.89
Pascagoula, MS	--	--	--	--	1.50	0.78
Mobile, AL	--	--	--	--	0.15	0.14

Note: -- equals a value of less than 0.005 for both a mean number of spills and a probability.

c. Trajectory Simulation

Oil spill trajectory simulations were conducted using seasonal surface currents coupled with wind data, adjusted every three hours for 30 days, until a target is contacted or the trajectory moves off the map. Hypothetical spill trajectories were simulated for each of the potential launch sites across the entire Gulf (Figure IV-2). These simulations presume 500 spills occurring in each of the four seasons of the year. The results are presented as probabilities (expressed as percent chance) that an oil spill starting at a particular launch site will contact a certain land segment within 3, 10, or 30 days. A summary of the trajectory analysis (for 10 days) for all launch sites across the Gulf that present a potential risk to the land segments is given in Table IV-6. This table illustrates that if, for example, an oil spill were to occur in the Western Gulf, the probability (expressed as percent chance) of contact with a certain land segment within 10 days ranges from less than 0.5% to 63%. The corresponding counties for the highest percent chance of contact are Matagorda County in Texas, Plaquemines Parish in Louisiana, and Franklin County in Florida.

d. Estimated Number of Oil Spills Occurring and Contacting Sensitive Resources

The final phase of the OSRA combines the projected mean number of spill occurrences with the probabilities of contact provided by the trajectory analyses. The results are given in a series of tables presenting two values for each land segment (Figure IV-3) and special target across the Gulf, in each of three time frames; 3, 10, and 30 days. The two values represent the probability of one or more spills to occur and contact the target, and the estimated mean number of spills that might occur and contact the target. Tables IV-7 and IV-8 are subsets of these tables showing only those land segments and special targets considered most at risk to contact by an oil spill resulting from development, production, or transportation Gulfwide and reaching these targets within 10 days. In many areas around the Gulf several sensitive resources occur within the same geographic limits. For the sake of efficiency in running the model, most of these areas were submitted only once with the results being renamed or combined to represent other resources in the same area. Following is a list of the targets submitted to the OSRA, which were also used by the Leasing and Environment staff in the Gulf of Mexico OCS Region to define a second set of resources in the same area.

Table IV-6

Probabilities (expressed as percent chance) that an Oil Spill Starting at a Particular Location will Contact a Certain Land Segment within 10 Days (Gulf Sales 123 and 125)

	Hypothetical Spill Location																		
Land Segment	W1	W2	W3	W4	W5	W6	W7	W8	W9	W12	W13	W14	W15	W16	W17	C30	C31	C32	C33
1	35	4							3										
2	16	6							2										
3	18	51	11		1	4			8										
4	1	19	31	2	3	7			3										
5		3	32	5	9	8		1											
6			12	20	10	6	1	1		1									
7			1	51	21	3	7	1		11									
8				5	7		3			51	12		12						
9										4	26	1	11	2	2				
10											27	36	4	16	4	1		1	
11												21		4		9		3	
12												4		1		50	10	14	5
13																2	36	1	8
14																	6		2
15																	1		1

	Hypothetical Spill Location																		
Land Segment	C36	C37	C38	C39	C40	C41	C42	C51	C52	C53	C54	C56	C57	C58	C59	C60	C61	C68	C69
13	7		3																
14	10		3																
15	13		4																
16	28	29	14	22	3	7	2	1											
17		29		15		7	1	10	1			3		2					
18		10		2		2		19	3			4		1					
19		3		3		2		36	73	18	11	41	13	16	10	3	2	1	1
20										7								8	2
21										3								29	8
22										1								19	8
23																		11	6

Table IV-6. Probabilities (expressed as percent chance) that an Oil Spill Starting at a Particular Location will Contact a Certain Land Segment within 10 Days (Gulf Sales 123 and 125) (continued)

	Hypothetical Spill Location																	
Land Segment	E70	E71	E72	E73	E76	E77	E78	E79	E80	E81	E84	E85	E89	E93	E97	E108	E115	E122
22	2		1															
23	20		5															
24	32	11	7	2														
25	2	17		3														
26		14		4	2													
27		6		5	16			1										
28					8			3										
29					2	28	4	6	7	1								
30						16	15			1								
31						4	22			3								
32							2			9	1	1						
33										1	1	10						
34												2						
35												1						
36													1					
37													1	2				
39															1			
41																3		
42																1	4	
43																		1

Source: Hannon and Lean, 1988.

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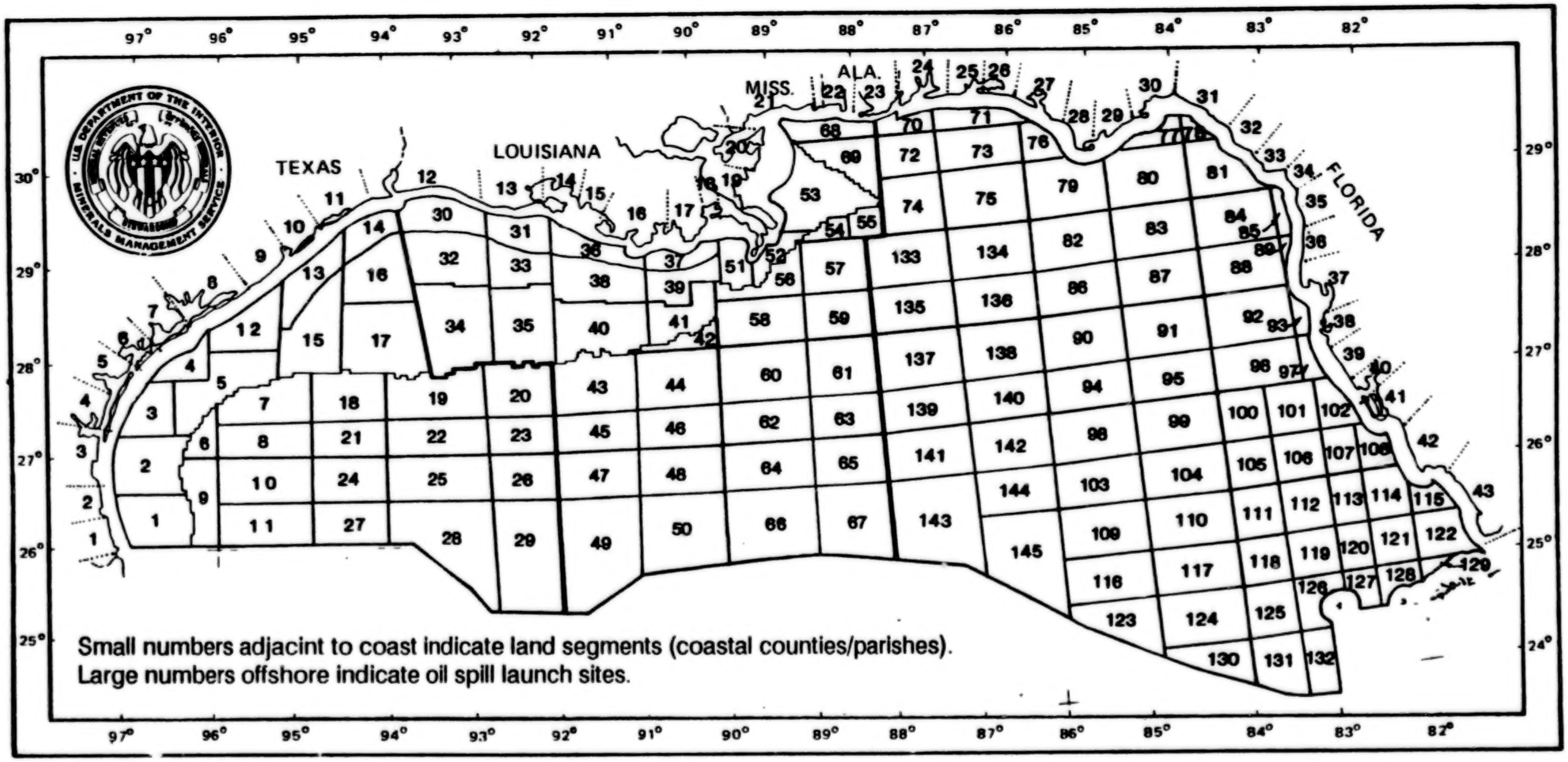

Small numbers adjacint to coast indicate land segments (coastal counties/parishes).
Large numbers offshore indicate oil spill launch sites.

Figure IV-3: Land segments and launch sites used in OSRA.

Table IV-7

Probabilities (expressed as percent chance) of One or More Spills and the Estimated Number of Spills (mean) Occurring and Contacting Environmental Resources within 10 Days Over the Expected Production Life of the Lease Area (Central Gulf Sale 123)

	Base Case (Central)		High Case (Central)		Total Planning Area (Central)		Imports		Aggregate (Gulfwide)	
Environmental Resource	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
3 - Kenedy, TX	-	-	-	-	-	-	2	*	3	*
4 - Kleberg, TX	-	-	-	-	-	-	6	0.1	8	0.1
5 - Nueces, TX et al.	-	-	-	-	-	-	17	0.2	22	0.3
6 - Aransas, TX	-	-	-	-	-	-	7	0.1	10	0.1
7 - Calhoun, TX	-	-	-	-	-	-	1	*	4	*
8 - Matagorda, TX	-	-	-	-	-	-	2	*	4	*
9 - Brazoria, TX	-	-	-	-	-	-	8	0.1	14	0.1
10 - Galveston, TX et al.	-	-	-	-	1	*	40	0.5	50	0.7
11 - Jefferson, TX	-	-	-	-	1	*	15	0.2	18	0.2
12 - Cameron, LA	-	-	-	-	10	0.1	21	0.2	30	0.4
13 - Vermilion, LA	-	-	-	-	15	0.2	-	-	15	0.2
14 - New Iberia, LA	-	-	-	-	12	0.1	-	-	13	0.1
15 - St. Mary, LA	-	-	1	*	16	0.2	-	-	16	0.2
16 - Terrebonne, LA	1	*	2	*	44	0.6	3	*	45	0.6
17 - Lafourche, LA	1	*	1	*	25	0.3	8	0.1	31	0.4
18 - Jefferson, LA	1	*	1	*	23	0.3	5	0.1	27	0.3
19 - Plaquemines, LA	2	*	5	*	63	1.0	26	0.3	73	1.3
20 - St. Bernard, LA et al.	-	-	-	-	3	*	2	*	6	0.1
21 - Hancock, MS et al.	-	-	-	-	4	*	12	0.1	17	0.2
22 - Mobile, AL	-	-	-	-	2	*	4	*	7	0.1
23 - Baldwin, AL	-	-	-	-	1	*	1	*	3	*
24 - Escambia, FL et al.	-	-	-	-	-	-	-	-	1	*
44 - Dade, FL	-	-	-	-	-	-	12	0.1	12	0.1
45 - Broward, FL	-	-	-	-	-	-	2	*	2	*
Land	5	0.1	10	0.1	94	2.8	89	2.2	99+	5.5
Western Gulf Archaeological Sites	-	-	-	-	1	*	54	0.8	63	1.0
Whooping Crane Foraging	-	-	-	-	-	-	1	*	4	*
Corpus Christi Brown Pelican Nest/Forage	-	-	-	-	-	-	30	0.4	38	0.5
Western Sea Turtle Nesting	-	-	-	-	-	-	13	0.1	17	0.2
Western Sea Turtle Foraging	-	-	-	-	1	*	42	0.5	52	0.7
North Padre Island Coastal Barrier	-	-	-	-	-	-	8	0.1	11	0.1
Mustang Island Coastal Barrier	-	-	-	-	-	-	17	0.2	22	0.3
St. Joseph Island Coastal Barrier	-	-	-	-	-	-	7	0.1	10	0.1
Matagorda Island Coastal Barrier	-	-	-	-	-	-	1	*	4	*
Matagorda Peninsula Coastal Barrier	-	-	-	-	-	-	2	*	4	*
Brazos Headland Coastal Barrier	-	-	-	-	-	-	8	0.1	14	0.1
Galveston Is./Bolivar Peninsula Coastal Barrier	-	-	-	-	1	*	40	0.5	50	0.7
Rollover Pass to Sabine Pass Coastal Barrier	-	-	-	-	1	*	15	0.2	18	0.2
Chenier Plain Coastal Barrier	-	-	1	*	24	0.3	21	0.2	41	0.5

Table IV-7. Probabilities (expressed as percent chance) of One or More Spills and the Estimated Number of Spills (mean) Occurring and Contacting Environmental Resources within 10 Days Over the Expected Production Life of the Lease Area (Central Gulf Sale 123) (continued)

Environmental Resource	Base Case (Central)		High Case (Central)		Total Planning Area (Central)		Imports		Aggregate (Gulfwide)	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
Laguna Madre Seagrass Beds	-	-	-	-	-	-	8	0.1	11	0.1
Corpus Christi Bay Seagrass Beds	-	-	-	-	-	-	17	0.2	22	0.3
Espiritu Santo/Matagorda Seagrass Beds	-	-	-	-	-	-	4	*	8	0.1
Galveston Seagrass Beds	-	-	-	-	1	*	40	0.5	50	0.7
Espiritu Santo/Matagorda Bays	-	-	-	-	-	-	4	*	8	0.1
Galveston Bay	-	-	-	-	1	*	40	0.5	50	0.7
Texas Coastal Marshes - Central	-	-	-	-	-	-	10	0.1	18	0.2
Texas Coastal Marshes - Eastern	-	-	-	-	2	*	53	0.8	64	1.0
Padre Is. Nat. Seashore/Mustang Is. Rec. Beaches	-	-	-	-	-	-	24	0.3	31	0.4
Matagorda Island Rec. Beaches	-	-	-	-	-	-	1	*	4	*
Matagorda County Rec. Beaches	-	-	-	-	-	-	2	*	4	*
Brazoria County Rec. Beaches	-	-	-	-	-	-	8	0.1	14	0.1
Galveston Is./Bolivar Peninsula Rec. Beaches	-	-	-	-	1	*	40	0.5	50	0.7
Sea Rim Rec. Beaches	-	-	-	-	1	*	15	0.2	18	0.2
Texas Rec. Beaches	-	-	-	-	2	*	65	1.0	78	1.5
Central Gulf Archaeological Sites	1	*	2	*	37	0.5	36	0.4	62	1.0
Timbalier Bay	1	*	2	*	37	0.5	8	0.1	42	0.5
Barataria Bay	2	*	4	*	60	0.9	21	0.2	68	1.1
Chandeleur/Breton Sound	-	-	-	-	13	0.1	11	0.1	23	0.3
Mississippi Sound	-	-	-	-	7	0.1	14	0.1	21	0.2
Vermilion/Atchafalaya Bays	-	-	1	*	26	0.3	-	-	26	0.3
Mobile Bay	-	-	-	-	2	*	5	0.1	9	0.1
Barataria Brown Pelican Nest/Forage	2	*	3	*	55	0.8	18	0.2	63	1.0
Chandeleur Brown Pelican Nest/Forage	-	-	-	-	9	0.1	10	0.1	19	0.2
Hancock County, MS, Pelican Habitat	-	-	-	-	4	*	12	0.1	17	0.2
Mobile County, AL, Pelican Habitat	-	-	-	-	2	*	4	*	7	0.1
Central Sea Turtle Nesting	-	-	-	-	6	0.1	12	0.1	18	0.2
Central Sea Turtle Foraging	3	*	6	0.1	77	1.5	19	0.2	82	1.7
Caminada Headland Coastal Barrier	1	*	2	*	38	0.5	13	0.1	46	0.6
Grand Isle/Grand Terre Coastal Barrier	1	*	1	*	23	0.3	5	0.1	27	0.3
West Plaquemines Coastal Barrier	3	*	6	0.1	70	1.2	33	0.4	81	1.6
Isle Dernier/Timbalier Is. Coastal Barrier	1	*	2	*	37	0.5	8	0.1	42	0.5
Chandeleur/Breton Coastal Barrier	-	-	-	-	13	0.1	11	0.1	23	0.3
Dauphin Island Coastal Barrier	-	-	-	-	2	*	4	*	7	0.1
Gulf Shores Coastal Barrier	-	-	-	-	1	*	1	*	3	*
East Deltaic Plain Marshes	1	*	1	*	36	0.4	15	0.2	46	0.6
West Deltaic Plain Marshes	6	0.1	11	0.1	93	2.2	43	0.5	96	3.2
Chenier Plain Marshes	-	-	1	*	24	0.3	21	0.2	41	0.5
W. Winter Menhaden Spawning Ground	1	*	2	*	44	0.6	1	*	45	0.6
C. Winter Menhaden Spawning Ground	2	*	3	*	49	0.7	23	0.3	61	0.9
E. Winter Menhaden Spawning Ground	-	*	1	*	26	0.3	20	0.2	42	0.5

Table IV-7. Probabilities (expressed as percent chance) of One or More Spills and the Estimated Number of Spills (mean) Occurring and Contacting Environmental Resources within 10 Days Over the Expected Production Life of the Lease Area (Central Gulf Sale 123) (continued)

	Base Case (Central)		High Case (Central)		Total Planning Area (Central)		Imports		Aggregate (Gulfwide)	
Environmental Resource	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
Timbalier Bay Seagrass Beds	1	*	2	*	37	0.5	8	0.1	42	0.5
Mobile Bay/Perdido Bay Seagrass Beds	-	-	-	-	2	*	5	0.1	9	0.1
Chandeleur Sound Seagrass Beds	-	-	-	-	13	0.1	11	0.1	23	0.3
Cameron Parish Rec. Beaches	-	-	-	-	10	0.1	21	0.2	30	0.4
Fourchon Rec. Beaches	1	*	1	*	25	0.3	8	0.1	31	0.4
Grand Isle Rec. Beaches	1	*	1	*	23	0.3	5	0.1	27	0.3
Mississippi Mainland Rec. Beaches	-	-	-	-	4	*	12	0.1	17	0.2
Gulf Islands National Seashore Rec. Beaches	-	-	-	-	7	0.1	14	0.1	21	0.2
Dauphin Island Rec. Beaches	-	-	-	-	2	*	4	*	7	0.1
Gulf Shores Rec. Beaches	-	-	-	-	1	*	1	*	3	*
Louisiana Rec. Beaches	2	*	2	*	48	0.7	31	0.4	65	1.0
Mississippi Rec. Beaches	-	-	-	-	11	0.1	24	0.3	34	0.4
Alabama Rec. Beaches	-	-	-	-	3	*	5	*	8	0.1
Eastern Gulf Archaeological Sites	-	-	-	-	-	-	27	0.3	29	0.3
Emerald Coast Coastal Barrier	-	-	-	-	-	-	-	-	2	*
Santa Rosa Sound Seagrass Beds	-	-	-	-	-	-	-	-	1	*
Florida Bay Seagrass Beds	-	-	-	-	-	-	2	*	2	*
Upper Keys Seagrass Beds	-	-	-	-	-	-	10	0.1	10	0.1
Lower Keys Seagrass Beds	-	-	-	-	-	-	11	0.1	11	0.1
Escambia/Pensacola Bays/Santa Rosa Sound	-	-	-	-	-	-	-	-	1	*
Biscayne Bay	-	-	-	-	-	-	12	0.1	12	0.1
Emerald Coast Rec. Beaches	-	-	-	-	-	-	-	-	1	*
Florida Rec. Beaches	-	-	-	-	-	-	-	-	1	*
Everglades Manatee	-	-	-	-	-	-	12	0.1	12	0.1
N. Florida Sea Turtle Nest/Forage	-	-	-	-	-	-	-	-	3	*
S. Florida Sea Turtle Nest/Forage	-	-	-	-	-	-	17	0.2	17	0.2
Keys Brown Pelican Nest/Forage	-	-	-	-	-	-	22	0.2	22	0.2
Dry Tortugas	-	-	-	-	-	-	12	0.1	13	0.1
Upper Florida Keys	-	-	-	-	-	-	10	0.1	10	0.1
Lower Florida Keys	-	-	-	-	-	-	11	0.1	11	0.1
Upper Keys Coral Reefs	-	-	-	-	-	-	10	0.1	10	0.1
Lower Keys Coral Reefs	-	-	-	-	-	-	11	0.1	11	0.1
Everglades Mangroves	-	-	-	-	-	-	12	0.1	12	0.1
Upper Keys Mangroves	-	-	-	-	-	-	10	0.1	10	0.1
Lower Keys Mangroves	-	-	-	-	-	-	11	0.1	11	0.1
Monroe County Tourism	-	-	-	-	-	-	20	0.2	20	0.2

Note: - = probability of less than 0.5% and a mean number of less than 0.05. Segments with less than 0.5% probability of one or more contacts within 10 days for all scenarios are not shown.
* = a mean number of spills of less than 0.05.

Source: Hannon and Lean, 1988.

Table IV-8

Probabilities (expressed as percent chance) of One or More Spills and the Estimated Number of Spills (mean) Occurring and Contacting Environmental Resources within 10 Days Over the Expected Production Life of the Lease Area (Western Gulf Sale 125)

Environmental Resource	Base Case (Western)		High Case (Western)		Total Planning Area (Western)		Imports		Aggregate (Gulfwide)	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
3 - Kenedy, TX	-	-	-	-	1	*	2	*	3	*
4 - Kleberg, TX	-	-	-	-	2	*	6	0.1	8	0.1
5 - Nueces, TX et al.	-	-	1	*	6	0.1	17	0.2	22	0.3
6 - Aransas, TX	-	-	-	-	3	*	7	0.1	10	0.1
7 - Calhoun, TX	-	-	-	-	3	*	1	*	4	*
8 - Matagorda, TX	-	-	-	-	2	*	2	*	4	*
9 - Brazoria, TX	-	-	1	*	6	0.1	8	0.1	14	0.1
10 - Galveston, TX et al.	1	*	2	*	16	0.2	40	0.5	50	0.7
11 - Jefferson, TX	-	-	-	-	2	*	15	0.2	18	0.2
12 - Cameron, LA	-	-	-	-	1	*	21	0.2	30	0.4
13 - Vermilion, LA	-	-	-	-	-	-	-	-	15	0.2
14 - New Iberia, LA	-	-	-	-	-	-	-	-	13	0.1
15 - St. Mary, LA	-	-	-	-	-	-	-	-	16	0.2
16 - Terrebonne, LA	-	-	-	-	-	-	3	*	45	0.6
17 - Lafourche, LA	-	-	-	-	-	-	8	0.1	31	0.4
18 - Jefferson, LA	-	-	-	-	-	-	5	0.1	27	0.3
19 - Plaquemines, LA	-	-	-	-	-	-	26	0.3	73	1.3
20 - St. Bernard, LA et al.	-	-	-	-	-	-	2	*	6	0.1
21 - Hancock, MS et al.	-	-	-	-	-	-	12	0.1	17	0.2
22 - Mobile, AL	-	-	-	-	-	-	4	*	7	0.1
23 - Baldwin, AL	-	-	-	-	-	-	1	*	3	*
24 - Escambia, FL et al.	-	-	-	-	-	-	-	-	1	*
44 - Dade, FL	-	-	-	-	-	-	12	0.1	12	0.1
45 - Broward, FL	-	-	-	-	-	-	2	*	2	*
Land	2	*	5	0.1	36	0.5	89	2.2	99+	5.5
Western Gulf Archaeological Sites	1	*	3	*	20	0.2	54	0.8	63	1.0
Whooping Crane Foraging	-	-	-	-	2	*	1	*	4	*
Corpus Christi Brown Pelican Nest/Forage	1	*	2	*	12	0.1	30	0.4	38	0.5
Western Sea Turtle Nesting	-	-	1	*	4	*	13	0.1	17	0.2
Western Sea Turtle Foraging	1	*	2	*	18	0.2	42	0.5	52	0.7
North Padre Island Coastal Barrier	-	-	-	-	3	*	8	0.1	11	0.1
Mustang Island Coastal Barrier	-	-	1	*	6	0.1	17	0.2	22	0.3
St. Joseph Island Coastal Barrier	-	-	-	-	3	*	7	0.1	10	0.1
Matagorda Island Coastal Barrier	-	-	-	-	3	*	1	*	4	*
Matagorda Peninsula Coastal Barrier	-	-	-	-	2	*	2	*	4	*
Brazos Headland Coastal Barrier	-	-	1	*	6	0.1	8	0.1	14	0.1
Galveston Is./Bolivar Peninsula Coastal Barrier	1	*	2	*	16	0.2	40	0.5	50	0.7
Rollover Pass to Sabine Pass Coastal Barrier	-	-	-	-	2	*	15	0.2	18	0.2
Chenier Plain Coastal Barrier	-	-	-	-	1	*	21	0.2	41	0.5

Table IV-8. Probabilities (expressed as percent chance) of One or More Spills and the Estimated Number of Spills (mean) Occurring and Contacting Environmental Resources within 10 Days Over the Expected Production Life of the Lease Area (Western Gulf Sale 125) (continued)

	Base Case (Western)		High Case (Western)		Total Planning Area (Western)		Imports		Aggregate (Gulfwide)	
Environmental Resource	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
Laguna Madre Seagrass Beds	-	-	-	-	3	*	8	0.1	11	0.1
Corpus Christi Bay Seagrass Beds	-	-	1	*	6	0.1	17	0.2	22	0.3
Espiritu Santo/Matagorda Seagrass Beds	-	-	-	-	5	0.1	4	*	8	0.1
Galveston Seagrass Beds	1	*	2	*	16	0.2	40	0.5	50	0.7
Espiritu Santo/Matagorda Bays	-	-	-	-	5	0.1	4	*	8	0.1
Galveston Bay	1	*	2	*	16	0.2	40	0.5	50	0.7
Texas Coastal Marshes - Central	-	-	1	*	8	0.1	10	0.1	18	0.2
Texas Coastal Marshes - Eastern	1	*	3	*	22	0.2	53	0.8	64	1.0
Padre Is. Nat. Seashore/Mustang Is. Rec. Beaches	1	*	1	*	9	0.1	24	0.3	31	0.4
Matagorda Island Rec. Beaches	-	-	-	-	3	*	1	*	4	*
Matagorda County Rec. Beaches	-	-	-	-	2	*	2	*	4	*
Brazoria County Rec. Beaches	-	-	1	*	6	0.1	8	0.1	14	0.1
Galveston Is./Bolivar Peninsula Rec. Beaches	1	*	2	*	16	0.2	40	0.5	50	0.7
Sea Rim Rec. Beaches	-	-	-	-	2	*	15	0.2	18	0.2
Texas Rec. Beaches	2	*	4	*	33	0.4	65	1.0	78	1.5
Central Gulf Archaeological Sites	-	-	-	-	1	*	36	0.4	62	1.0
Timbalier Bay	-	-	-	-	-	-	8	0.1	42	0.5
Barataria Bay	-	-	-	-	-	-	21	0.2	68	1.1
Chandeleur/Breton Sound	-	-	-	-	-	-	11	0.1	23	0.3
Mississippi Sound	-	-	-	-	-	-	14	0.1	21	0.2
Vermilion/Atchafalaya Bays	-	-	-	-	-	-	-	-	26	0.3
Mobile Bay	-	-	-	-	-	-	5	0.1	9	0.1
Barataria Brown Pelican Nest/Forage	-	-	-	-	-	-	18	0.2	63	1.0
Chandeleur Brown Pelican Nest/Forage	-	-	-	-	-	-	10	0.1	19	0.2
Hancock County, MS, Pelican Habitat	-	-	-	-	-	-	12	0.1	17	0.2
Mobile County, AL, Pelican Habitat	-	-	-	-	-	-	4	*	7	0.1
Central Sea Turtle Nesting	-	-	-	-	-	-	12	0.1	18	0.2
Central Sea Turtle Foraging	-	-	-	-	1	*	19	0.2	82	1.7
Caminada Headland Coastal Barrier	-	-	-	-	-	-	13	0.1	46	0.6
Grand Isle/Grand Terre Coastal Barrier	-	-	-	-	-	-	5	0.1	27	0.3
West Plaquemines Coastal Barrier	-	-	-	-	-	-	33	0.4	81	1.6
Isle Dernier/Timbalier Is. Coastal Barrier	-	-	-	-	-	-	8	0.1	42	0.5
Chandeleur/Breton Coastal Barrier	-	-	-	-	-	-	11	0.1	23	0.3
Dauphin Island Coastal Barrier	-	-	-	-	-	-	4	*	7	0.1
Gulf Shores Coastal Barrier	-	-	-	-	-	-	1	*	3	*
East Deltaic Plain Marshes	-	-	-	-	-	-	15	0.2	46	0.6
West Deltaic Plain Marshes	-	-	-	-	-	-	43	0.5	96	3.2
Chenier Plain Marshes	-	-	-	-	1	*	21	0.2	41	0.5
W. Winter Menhaden Spawning Ground	-	-	-	-	1	*	1	*	45	0.6
C. Winter Menhaden Spawning Ground	-	-	-	-	-	-	23	0.3	61	0.9
E. Winter Menhaden Spawning Ground	-	-	-	-	-	-	20	0.2	42	0.5

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Table IV-8. Probabilities (expressed as percent chance) of One or More Spills and the Estimated Number of Spills (mean) Occurring and Contacting Environmental Resources within 10 Days Over the Expected Production Life of the Lease Area (Western Gulf Sale 125) (continued)

Environmental Resource	Base Case (Western)		High Case (Western)		Total Planning Area (Western)		Imports		Aggregate (Gulfwide)	
	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean	Prob	Mean
Timbalier Bay Seagrass Beds	-	-	-	-	-	-	8	0.1	42	0.5
Mobile Bay/Perdido Bay Seagrass Beds	-	-	-	-	-	-	5	0.1	9	0.1
Chandeleur Sound Seagrass Beds	-	-	-	-	-	-	11	0.1	23	0.3
Cameron Parish Rec. Beaches	-	-	-	-	1	*	21	0.2	30	0.4
Fourchon Rec. Beaches	-	-	-	-	-	-	8	0.1	31	0.4
Grand Isle Rec. Beaches	-	-	-	-	-	-	5	0.1	27	0.3
Mississippi Mainland Rec. Beaches	-	-	-	-	-	-	12	0.1	17	0.2
Gulf Islands National Seashore Rec. Beaches	-	-	-	-	-	-	14	0.1	21	0.2
Dauphin Island Rec. Beaches	-	-	-	-	-	-	4	*	7	0.1
Gulf Shores Rec. Beaches	-	-	-	-	-	-	1	*	3	*
Louisiana Rec. Beaches	-	-	-	-	1	*	31	0.4	65	1.0
Mississippi Rec. Beaches	-	-	-	-	-	-	24	0.3	34	0.4
Alabama Rec. Beaches	-	-	-	-	-	-	5	*	8	0.1
Eastern Gulf Archaeological Sites	-	-	-	-	-	-	27	0.3	29	0.3
Emerald Coast Coastal Barrier	-	-	-	-	-	-	-	-	2	*
Santa Rosa Sound Seagrass Beds	-	-	-	-	-	-	-	-	1	*
Florida Bay Seagrass Beds	-	-	-	-	-	-	2	*	2	*
Upper Keys Seagrass Beds	-	-	-	-	-	-	10	0.1	10	0.1
Lower Keys Seagrass Beds	-	-	-	-	-	-	11	0.1	11	0.1
Escambia/Pensacola Bays/Santa Rosa Sound	-	-	-	-	-	-	-	-	1	*
Biscayne Bay	-	-	-	-	-	-	12	0.1	12	0.1
Emerald Coast Rec. Beaches	-	-	-	-	-	-	-	-	1	*
Florida Rec. Beaches	-	-	-	-	-	-	-	-	1	*
Everglades Manatee	-	-	-	-	-	-	12	0.1	12	0.1
N. Florida Sea Turtle Nest/Forage	-	-	-	-	-	-	-	-	3	*
S. Florida Sea Turtle Nest/Forage	-	-	-	-	-	-	17	0.2	17	0.2
Keys Brown Pelican Nest/Forage	-	-	-	-	-	-	22	0.2	22	0.2
Dry Tortugas	-	-	-	-	-	-	12	0.1	13	0.1
Upper Florida Keys	-	-	-	-	-	-	10	0.1	10	0.1
Lower Florida Keys	-	-	-	-	-	-	11	0.1	11	0.1
Upper Keys Coral Reefs	-	-	-	-	-	-	10	0.1	10	0.1
Lower Keys Coral Reefs	-	-	-	-	-	-	11	0.1	11	0.1
Everglades Mangroves	-	-	-	-	-	-	12	0.1	12	0.1
Upper Keys Mangroves	-	-	-	-	-	-	10	0.1	10	0.1
Lower Keys Mangroves	-	-	-	-	-	-	11	0.1	11	0.1
Monroe County Tourism	-	-	-	-	-	-	20	0.2	20	0.2

Note: - = probability of less than 0.5% and a mean number of less than 0.05. Segments with less than 0.5% probability of one or more contacts within 10 days for all scenarios are not shown.
* = a mean number of spills of less than 0.05.

Source: Hannon and Lean, 1988.

The results from:	Also represent:
Timbalier Bay	Timbalier Bay Seagrass Beds Isle Dernier/Timbalier Island Coastal Barrier
Chandeleur/Breton Coastal Barrier	Chandeleur Sound Seagrass Beds Chandeleur/Breton Sound
Upper Keys, Lower Keys, and Florida Bay Seagrass Beds	Keys Brown Pelican Nesting/Foraging
Mississippi Sound	Gulf Islands National Seashore Rec. Beaches
West Plaquemines Coastal Barrier and Land Segments 14, 15, 16, 17, and 18	West Deltaic Plains Marshes
Upper Florida Keys	Upper Keys Mangroves Upper Keys Seagrass Beds Upper Keys Coral Reefs
Lower Florida Keys	Lower Keys Mangroves Lower Keys Seagrass Beds Lower Keys Coral Reefs
Land Segment 43 Upper Florida Keys Lower Florida Keys	Monroe County Tourism
Land Segment 21	Hancock County, MS, Pelican Habitat
Land Segment 22	Mobile County, AL, Pelican Habitat

The following recreational beach targets were combined to give statewide recreational beach values:

Texas Rec. Beaches	Brazos/South Padre Is. Rec. Beaches Padre Is. National Seashore/Mustang Is. Rec. Beaches Matagorda Is. Rec. Beaches Matagorda County Rec. Beaches Brazoria County Rec. Beaches Galvestion Is./Bolivar Peninsula Rec. Beaches Sea Rim Rec. Beaches
Louisiana Rec. Beaches	Cameron Parish Rec. Beaches Fourchon Rec. Beaches Grand Isle Rec. Beaches
Mississippi Rec. Beaches	Gulf Is. National Seashore Rec. Beaches Mississippi Mainland Rec. Beaches
Alabama Rec. Beaches	Dauphin Is. Rec. Beaches Gulf Shores Rec. Beaches

Florida Rec. Beaches	Emerald Coast Rec. Beaches
	Panama City Beach Rec. Beaches
	St. Joseph Spit Rec. Beaches
	Franklin County Rec. Beaches
	Central Florida Rec. Beaches

For each planning area the appropriate table shows the risk from several sources of oil, both from within and from outside the planning area. These include the proposed volume expected to be discovered and produced as a result of this sale, the Base Case, and a High Case for the proposal. Estimates for volumes of oil expected to be produced as a result of prior sales in this planning area, as well as for future sales, are added to the Base Case volume to indicate the risk presented by all OCS activities within the planning area. This Total Planning Area (TPA) volume is combined with other TPA's and imports of foreign crude into the Gulf to indicate the risk of oil spills from all activities--the Aggregate--on the Federal OCS.

The 3-, 10-, and 30-day increments were selected to represent three critical phases of a spill; the greatest toxicity, the maximum slick size, and tarball formation, respectively. Because of the characteristics of the crude oil expected to be produced in the Gulf and because the values for "within 10 days" necessarily include the values for the "within 3 days" category, most analyses in this EIS will focus on the 10-day values, considering this a conservative approach. In the OSRA run for the Base Case, only one land segment shows a detectable chance of a spill occurring and contacting it within 3 days. This is Plaquemines Parish in the Central Gulf. No spills were estimated to occur and contact any of the land segments in the Eastern or Western Gulf as a result of the Base Case. In all cases the probabilities and mean values are lower than those for 10 days. For the 30-day increment, there are 14 land segments in the Western and Central Gulf with detectable values and none in the Eastern Gulf. These are shown below.

Western Gulf

Land Segment	Prob.	Mean
3-Kenedy, TX	1	0.0
4-Kleberg, TX	1	0.0
5-Nueces, TX	1	0.0
6-Aransas, TX	1	0.0
7-Calhoun, TX	1	0.0
8-Matagorda, TX	1	0.0
9-Brazoria, TX	1	0.0
10-Galveston, TX et al.	1	0.0

Central Gulf

Land Segment	Prob.	Mean
12-Cameron, TX	1	0.0
13-Vermilion, LA	1	0.0
16-Terrebonne, LA	3	0.0
17-Lafourche, LA	1	0.0
18-Jefferson, LA	1	0.0
19-Plaquemines, LA	4	0.0

2. Chronic and Small Spills

Statistics on oil spill events occurring in connection with OCS activities have been maintained since 1964. Requirements for the reporting of spills to MMS have varied over time as to the size classes to be reported and protocols for reporting. Presently, 30 CFR 250.41 regulations require that industry report in writing to MMS all spills over one barrel. It was not until 1978 that Congress charged the Department of the Interior with the responsibility to report publicly on major OCS accidents. Given known variations in historical reporting requirements, statistics on spills of less than 1,000 bbls should not be viewed as representing an accurate counting of all spills that have occurred, but it should be considered a tool for understanding historical events.

Table IV-9 contains data on the annual number and volume of spills occurring in connection with OCS oil and gas development operations. The numbers are shown in relationship to the number of offshore structures and annual OCS oil and condensate production. These data are compiled from the OCS Events File, a database maintained by the Gulf of Mexico OCS Region. This database was reviewed during the summer of 1988; a number of duplications found through careful examination of each historical event were purged. Because of this, the statistics presented may deviate slightly from past statistical summaries.

Table IV-9

Number and Volume of Oil Spills[a] Associated with Oil and Gas Operations on the Gulf of Mexico Outer Continental Shelf

Year	>1 bbl and ≤50 bbls		>50 bbls and <1,000 bbls		≥1,000 bbls		Number of Structures	Annual OCS Oil and Condensate Production (MMB)
	Number of Incidents	Volume of Oil Spilled	Number of Incidents	Volume of Oil Spilled	Number of Incidents	Volume of Oil Spilled		
1964					3	14,428	1,100	122
1965					1	1,688	1,200	145
1966					0		1,325	189
1967					1	160,633	1,450	222
1968					1	6,000	1,575	267
1969					2	10,032	1,675	303
1970					2	83,000	1,800	336
1971					0[b]		1,891	387
1972					0		1,935	389
1973					3	21,935	2,001	376
1974					2	23,333	2,054	344
1975					0		2,079	315
1976	65	299	2	714	1	4,000	2,096	303
1977	68	456	2	550	0		2,248	292
1978	73	374	3	1,139	0		2,327	280
1979	102	579	3	546	1	1,500	2,420	275
1980	45	233	7	1,075	1	1,456	2,554	267
1981	45	231	3	202	1	5,100	2,744	270
1982	54	252	3	842	0		2,851	293
1983	74	515	6	939	0		3,038	318
1984	50	241	1	100	0		3,199	340
1985	52	277	6	1,254	0		3,360	360
1986	33	121	1	210	0		3,448	360
1987	20	88	1	84	0		3,539	333
1988					1	14,944		
Total	681	3,664	38	7,655	20	348,049		

[a] Includes crude oil, condensate, and diesel spills occurring due to OCS exploration, development, and production activities from rigs, platforms, and pipelines. Does not include oil spills occurring from the shuttle tankering or barging of the produced oil to shore-based facilities.

[b] A crude oil spill of 53,000 bbls began in December 1, 1970, and continued into 1971, ending April 17, 1971.

Source: USDI, MMS, Gulf of Mexico OCS Region, OCS Events File, status as of January 1989.

For purposes of analysis, small spills are defined as spills less than 1,000 bbls. These spills can be further divided into two categories--spills greater than 1 bbl and less than or equal to 50 bbls (> 1 and ≤ 50 bbls) and spills greater than 50 bbls and less than 1,000 bbls (> 50 and < 1,000 bbls). Spills of 50 bbls or less are often termed chronic spillage. The database on spills less than or equal to one barrel cannot be expected to be accurate; therefore, these spills are not considered in the assumptions concerning numbers described below.

Spill sources include pipeline leaks or breaks and platform mishaps. No information is maintained by MMS on small spills from tankering operations.

a. Historic Small Spill Rates

The following spill rates were calculated for spill sizes less than 1,000 bbls relative to production data. The MMS OCS Events File's small spill data prior to 1976 are inconsistent. Because of this, the spill rate for spills > 1 and ≤ 50 bbls was calculated using the number of spills and the adjusted annual oil production from 1976 to 1987. The spill rates for spills greater than 50 bbls cover the years from 1964 to 1987. Furthermore, small spill rates differ from rates calculated for spills of 1,000 bbls or greater (Section IV.B.1.a.) because they are simple averages rather than statistically derived rates that take into account a trend analysis. Because it has been shown that the number of these large spill events occurring relative to production have declined over time due to improved safety practices, the rates should be viewed as very conservative estimates (Anderson and LaBelle, 1988).

The small spill rates for the two categories are:

Spill Size	Spill Rate (spills/billion bbls produced)
> 1 and ≤ 50 bbls	185
> 50 and < 1,000 bbls	10

b. Estimated Mean Number of Small Spills Occurring Due to the Proposed Actions

The numbers of small spills estimated to occur due to the Base Case, High Case, and Total Planning Area (Section IV.A.) are obtained by multiplying the above small spill rates by the volumes of oil resources projected for each development scenario. Total Planning Area production equals the future production of existing resources, plus the undiscovered resources, for each planning area and for all prior, proposed, and future sales.

The number of spills in the size class > 1 and ≤ 50 bbls calculated to occur due to the Base Case and High Case for Sales 123 and 125, and the scenario for the Total Planning Area over the expected 34-year lease life are (numbers are rounded means):

	Base Case	High Case	Total Planning Area
WPA	19	41	284
CPA	31	61	1,110

The number of spills in the size class > 50 and < 1,000 bbls calculated to occur due to the Base Case and High Case for Sales 123 and 125, and the scenario for the Total Planning Area over the expected 34-year lease life are (numbers are rounded means):

	Base Case	High Case	Total Planning Area
WPA	1	2	15
CPA	2	3	60

c. Small Spill Assumptions

Intuitively, these spills would occur randomly distributed among the platform locations and along pipeline routes during the 34-year lease life of each proposed sale. In order to represent this scenario, the estimated mean numbers of small spills were spread over the CPA and WPA. Distribution of the spill events was based on an arithmetic weighting of proposed action oil resource estimates and existing and projected pipeline percentages occurring in each analysis area (analysis areas are shown on Figure IV-1). Analysis areas were further divided into offshore segments and segments in proximity to coastal analysis areas (Federal waters near the State/Federal boundary) to provide information for the assessment of coastal resource impacts. This division was hypothetical and was based on the assumption that spills occurring beyond the nearshore areas would not likely reach shoreline environmental resources.

Based on the above, qualitative assumptions about the probable numbers of small spills occurring and contacting resources were made to provide a consistent basis for the analysis of the impacts of small spills occurring in the Gulf of Mexico. Assumptions for the cumulative scenario and High Case are described within the impact analyses of Section IV.D.

For the Base Case in the CPA and WPA, it is assumed that a small spill of the size category > 1 and ≤ 50 bbls is likely to occur each year in each planning area, that a low percentage of these spills will occur in proximity to coastal resources, that a few of these spills will contact the CPA coastline during the 34-year lease life, and that one spill in this size class will contact the WPA coastline during the 34-year lease life. For the small spill category of > 50 and < 1,000 bbls, it is assumed that a spill this size would occur during the 34-year lease life in each planning area; however, none would contact the coastline.

For the High Case in the CPA and WPA, it is assumed that a few spills in the size class > 1 and ≤ 50 bbls will occur each year in each planning area, that a low percentage of these spills will occur in proximity to coastal resources, and that a few of these spills will contact the coastlines of both the CPA and WPA during the 34-year lease life. For the small spill size class of > 50 and < 1,000 bbls, it is assumed that a few spills will occur during the 34-year lease life in each planning area and that one of these spills will contact the coastline of each planning area.

For the Total Planning Area (to be used in the cumulative analysis) for the CPA, it is assumed that a moderate (between 25 and 75) number of small spills in the size class > 1 and ≤ 50 bbls will occur each year. A few of these spills will occur each year in each CPA OCS analysis area in proximity to coastal environments, and a few will contact the CPA coastline each year. For the Total Planning Area Scenario for the WPA, it is assumed that a few spills in the size class > 1 and ≤ 50 bbls will occur each year. Of these spills, a low percentage (less than one per year) will occur in proximity to coastal resources, and very few of these spills will contact the coastline during the 34-year lease life.

For the Total Planning Area for the CPA, it is assumed that a few spills in the size class > 50 and < 1,000 bbls will occur each year. Of these, a few spills are assumed to contact the CPA coastline during the 34-year lease life. For the same development scenario and small spill size in the WPA, it is assumed that several spills will occur during the 34-year lease life. Of these, less than one spill per year will occur, and only one spill is assumed to contact the coastline during the 34-year lease life.

It is assumed that spills of one barrel or less will not contribute to any measurable extent to the short-term impact of oil spills on sensitive environmental resources. This is due to the fact that such small spills will weather rapidly, exhibiting an extremely short life as a slick. Once the oil components are dissipated into the atmosphere and water column, they can contribute to the overall hydrocarbon loadings in the air and water. Impacts from chronic long-term contamination by petroleum hydrocarbons on air and water quality will be analyzed.

3. Assumptions about the Characteristics and Fates of a Typical Gulf of Mexico Oil Spill

a. Characteristics

South Louisiana crude is a typical crude oil from [illegible] Gulf of Mexico Region. Approximately 95% of the oil produced in this area resembles the characteristics of South Louisiana crude presented below.

Typical Gulf of Mexico Oil Spill Characteristics

Properties: South Louisiana Crude	
API Gravity (20°C)	34.5
wt% Naptha Fraction (boiling from 20° to 150°C)	18.6
wt% Saturates - High boiling	56.3
wt% Aromatics - High boiling	16.5
wt% Insolubles (asphaltenes)	0.2
wt% Polar Materials	8.4

Source: Jordan and Payne, 1980.

Although the chemical composition of crude oils from different producing regions and even from within a particular formation can vary tremendously, historically, the vast majority of oil spills in the Gulf of Mexico from OCS production have been composed of this light, very low asphaltene oil.

b. Size

In order to evaluate the fate of a large oil spill occurring in association with OCS oil development activities, it is necessary to determine an average size spill based on historical records. Although the most likely size large spill seen through examination of past spill events was around 2,000 bbls, an average size spill was determined to be 17,222 bbls. This was due to the occurrence of a few extremely large spills. Assumptions made in this discussion about any chemical and physical alterations to spilled oil is based on this average size large spill.

c. Weathering

The differing chemical compositions of crude oil and the weathering changes that occur over time to the spilled oil composition influence greatly its effects on the marine environment. Weathering involves a number of physical/chemical and biological processes that change the characteristics of the crude oil mixture and reduce the concentration of oil components in the slick. These processes include evaporation, dispersion, dissolution, emulsification, biodegradation, photo-oxidation, sinking, and sedimentation. Any or all of these processes can be expected to operate on spilled oil. Their relative importance are largely dependent on oceanographic and meteorological conditions at the time of the spill. Eventually, a tar-like residue would be left, which would break up into tar lumps or tar balls. Types of weathering processes and transport pathways of spilled oil at sea are depicted in Figure IV-4. Figure IV-4 and Table IV-6 of Final EIS 113/115/116 (USDI, MMS, 1987b) provide a description of the major weathering processes that affect the fate of spilled oil.

Spilled Louisiana crude disperses and degrades rapidly under the influences of the Gulf's warm climatic conditions and the properties of the oil. Expected time spans for the occurrence of weathering processes are shown in Table IV-10, as well as the percent volume loss from the original slick after 10 and 30 days. The most likely percent loss due to a given process for Louisiana crude is the first number given whenever a range is provided. Because Louisiana crude evaporates rapidly, slicks observed in Gulf waters have disappeared within days. Very few oil slicks have ever been tracked for more than 30 days. Spills from the *Torrey Canyon*, *Amoco Cadiz*, and *Ixtoc I* (which released oil over a long time period) remained on the sea surface longer than 30 days, but their volume was many times larger than the average spill described. In contrast, a slick from South Pass Block 60 of 42,000 bbls, spilled on August 2, 1973, was reported dissipated with only small patches remaining after only 5 days. Based on the above, 10 days is chosen as the most likely sea surface residence time, and it is the length of time modeled in the OSRA process (Section IV.B.1.). Assumptions regarding dominant weathering processes indicate that after 10 days, the oil properties have changed extensively. The original volume has decreased greatly. The floating oil is largely devoid of its volatile (acutely toxic) components and is gradually forming emulsions. Based on calculations made using the Fay-Hoult spreading model (Fay, 1971), the maximum slick diameter (6.2 km) of an average Gulf oil spill would be reached in 4 days. The maximum area covered would be 378.5 km^2. Once a slick reaches its maximum size, under favorable environmental conditions, it tends to break up into patches. These patches are generally influenced by the mean current, but they are also subjected to random eddies which could spread the patches over a large area.

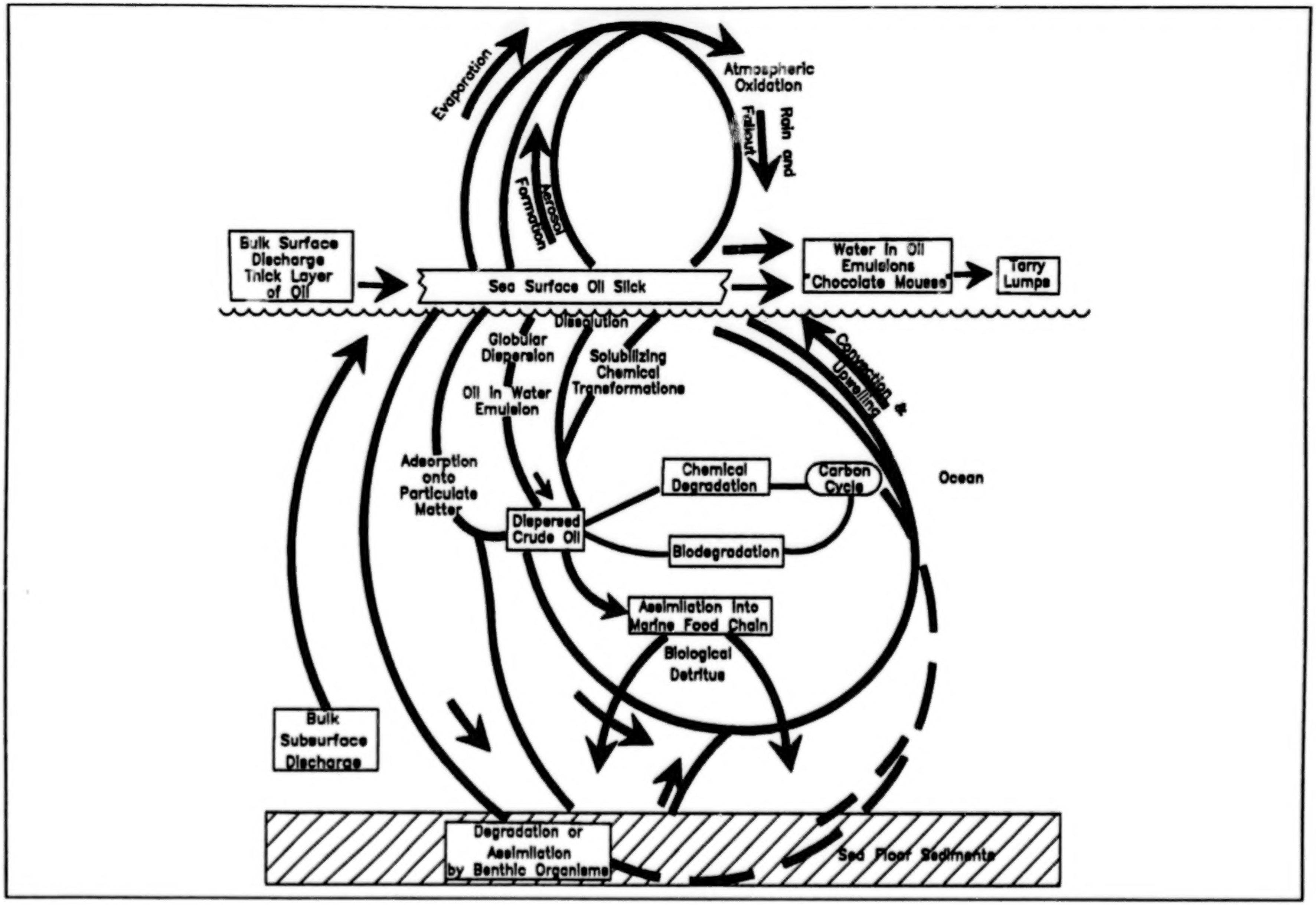

Figure IV-4: Processes Affecting the Fate of Spilled Oil (reprinted from Jordan and Payne, 1980).

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Table IV-10

Mass Balance of an Average South Louisiana Crude Spill[1]

Process	Time Scale (in days)	% Loss of Original Slick Volume (10 days)	% Loss of Original Slick Volume (30 days)
Evaporation	1-10	45%*-25%	45%*-25%
Dissolution	1-10	<1%	1%*-5%
Dispersion	1-30	10%	included in sinking and sedimentation rate
Auto-oxidation	3-365	<1%	5%
Biodegradation	5-720	1%	included in sinking and sedimentation rate
Sinking and Sedimentation	10-365	1%	34%*-20%
Tar Residue	10-365	<1%	1%*-30%
Offshore Skimming and Recovery Cleanup Operations		10%	15%
Total Volume Loss from Water Surface		67%*-47%	100%

[1] Assumption is that spill does not contact land.

*Ranges given provide an overview of crude oil fate in general. The first number (with an asterisk) represents the most likely percent loss of Louisiana crude due to that process.

Source: USDI, MMS, 1984d.

d. Oil in the Water Column

When initially spilled, most crude oils float. However, some of the spilled oil is found dispersed and retained in the water column. The weathering mechanisms that result in surface oil being retained in the water column include dissolution, dispersion, sinking, and sedimentation. The IXTOC subsurface spill resulted in higher concentrations of oil in the water column than usually measured under surface slicks. It was theorized that a new mechanism--subsurface plume formation--was responsible for the phenomena. Subsurface spillage is discussed in the next section.

About 1%-5% of the volume of the surface slick is predicted to occur in the water column in the vicinity of the spill. Some of this oil will reach bottom sediments (Mackay et al., 1979; Rhode Island, University of and Applied Science Associates, 1981; Boehm and Fiest, 1980b). The relative amount of oil which resides in the water column is a function of a number of factors, including the chemical and physical nature of the oil, the point of release (surface versus subsurface), and the hydrographic conditions affecting the slick formed (particularly the sea surface turbulence). The location of subsurface oil is governed by the density stratification of the water column. The submerged oil exists in association with strong temperature and salinity gradients.

Fiest and Boehm (1980) reviewed the literature and found that the average reported concentrations of oil in water generally were less than 1 ug/1 for pristine areas, 2-100 ug/1 for spills occurring in nearshore areas, and 100-800 ug/1 in heavily polluted urban environments. General background values for the Gulf of Mexico were from nondetectable to 70 ug/1. The higher value indicates a chronic paraffinic oil intrusion.

The concentrations of oil in the water column measured around the site of the IXTOC I blowout ranged from values of less than 5 ug/1 at a distance of 80 km from the blowout to peak values of 10,600 ug/1 within a few hundred meters of the wellhead. The highest concentrations were observed within 25 km of the blowout in the top 6 m of the water column (Fiest and Boehm, 1980).

Subsurface Spills

Most analyses of the fate of spilled oil assume that the oil originates on the surface of a water body. However, oil spillage could occur from underwater pipelines or subsurface blowouts associated with OCS oil industry activities. The following information is based mainly on the results of a large effort undertaken by the research teams studying the IXTOC I blowout (Payne et al., 1980a and 1980b; Fiest and Boehm, 1980; Boehm and Fiest, 1980a and 1980b; Walter and Proni, 1980). The PEMEX IXTOC I subsurface blowout occurred offshore Mexico on June 9, 1979, spilling approximately 10,000 bbls a day until capped in March 1980. This spill provided the first major opportunity to focus studies on the subsurface transport processes affecting spilled petroleum.

Subsurface Plume Formation

Fiest and Boehm (1980), Walter and Proni (1980), and others examined the characteristics of the IXTOC I blowout. They determined that a significant quantity of the oil released formed a subsurface plume of oil droplets found suspended in a mixed layer at depths of 5-20 m. The subsurface petroleum plume, representing approximately 3% of the spilled oil, was transported by ocean currents (Boehm and Fiest, 1982). An oceanic frontal system may have acted as a barrier to the lateral transport of the oil plume and may also have acted as a conduit for the subsurface movement of oil along the frontal axis. Within 5 km from the wellhead, the subsurface plume was made up of oil droplets greater than 0.45 um and had petroleum hydrocarbon concentrations greater than 600 ug/1. Such whole oil was found at concentrations greater than 20 ug/1 at 20 m depths within 25 km from the well (Fiest and Boehm, 1980). Although there appeared to be unidentified processes controlling the transport of the subsurface plume which differ from those controlling the movement of the surface slick, the subsurface plume was, for the most part, aligned with the surface slick.

Water samples taken from this subsurface plume were considerably enriched in light aromatic hydrocarbons relative to other aromatic components, presumably due to the presence of considerable quantities of soluble, solubilized, or colloidal material in the water. These light aromatic hydrocarbons are usually lost to the atmosphere due to evaporation from oil spilled on the ocean surface. The fact that the subsurface oil can be characterized by a different chemistry and weathering regime implies that the subsurface oil is a "fresh" oil plume which has remained subsurface since its discharge and in which evaporative loss of aromatics is greatly decreased (Boehm and Fiest, 1980b).

Of particular importance is the fact that concentrations of some of the more toxic components appeared in the water column in sizeable amounts. The concentrations of individual hydrocarbons in the dissolved fraction (0.01-3 ppb) measured in a study by Boehm and Fiest (1980b) following the IXTOC I blowout appeared to lie below the toxic range, even in the acute impact zone. However, the total concentration of waterborne low-molecular-weight aromatics (alkyl benzenes and naphthalene compounds) in water fell in the 0.5-500 ppb range, and concentrations of total waterborne oil dispersion were in the 100-10,000 ppb (0.10-10 ppm) range. The researchers report that these values fall well within the range causing observable effects on marine organisms.

e. Long-Term Fate

Natural weathering and degradation processes will remove nearly all of the original volume of the spilled surface slick within 30 days. The residue left behind bears little resemblance to the original material. The resulting tarry residue will break up into smaller fragments from continuing wave action and form tar balls in the water column. Tar balls generally contain higher weight hydrocarbons (asphaltenes) and oxygenated sulphur-containing compounds. Further degradation is retarded since the surface-to-volume ratio of unspread tar is small and tar balls are resistant to microbial degradation; therefore, their lifetime could be on the order of several months to years (Geyer, 1980). Some tar balls reach the coast. An average of 14,000 bbls of floating tar exist in the Gulf of Mexico (Geyer, 1981).

Some researchers have determined that Louisiana crude and some other northern Gulf Coast crudes do not form tar balls (Jeffrey et al., 1974) because of low asphaltene. Tar ball formation would be limited to spherical accretion caused by persistent convergence and supply to the oil residues (Heaton et al., 1980). In contrast, Geyer (1980) reports that as much as 20% of most oil discharged to the ocean could remain in the form of tar balls or lumps. Spills of oil in the Gulf not due to OCS oil development may form a significantly higher percentage of tar material.

Interaction with Shoreline

The most harmful effects of an oil spill occur once the slick reaches its ultimate destination--land. The following table outlines the factors that must be examined in order to predict the fate of oil once it reaches sandy beaches.

Relative Significance of Some Factors that Determine
the Persistence of Oil Stranded on the Shoreline

Types of Oil	Thickness of Oil on Shore Surface	Depth of Oil Penetration	Wave Energy Level at Shoreline	Air Temperature
Light	Very thin (< 1.0 cm)	Most oil exposed on shore surface	High energy: Exposed coast	High (> 25°C)
Heavy	Thick (> 10.0 cm)	Most oil buried below beach surface	Low energy: Protected coast	Low (0°C)

Sources: Owens, 1979.
Tortell, 1980.

The distribution and physical dispersion of an oil slick once it contacts a coastline is a result of the level of kinectic energy of the coastline--the abrasion and sediment scouring by wave activity--tidal stage, and the oil quantity. Oil is quickly eliminated in areas exposed to direct wave attack. Much of the oil beached on the Texas shoreline from the IXTOC blowout was removed during a hurricane. Persistence of stranded oil is determined by the rates of natural degradation and physical dispersal. Compacted sediments prevent deep penetration of oil; burial of oil is usually limited to 10-20 cm. Most oil is removed from the beach face in months; however, deeply buried oil can persist for longer periods.

In the Bay Marchand 1970 oil spill of 53,000 bbls, the self-cleaning phenomena of south Louisiana beaches was the most effective means of removing oil from the beaches. The beaches cleaned themselves in a few days after oil was deposited due to (1) the sand being hard packed and, therefore, resistant to penetration by oil and emulsified oil and (2) the beaches were narrow and shallow; therefore, they were easily swept clean by the changing tides (Berry, 1972).

Ultimate Fate--Recovery of a System

The ultimate fate of environmentally dispersed petroleum in open water is poorly understood. A study by Energy Resources Co. for BLM (1982) found no IXTOC I oil in offshore South Texas OCS (STOCS) sediments. Only 2% of the oil spilled from the IXTOC I blowout was ever accounted for (either found on beaches or residing offshore in tar mats). Perhaps 5-10 times as much oil passed through the Texas OCS region, largely in the form of small patches of emulsified oil. The researchers believed the oil could be tied up with the mobile, suspended sedimentary material (nepheloid layer) that exists near the bottom sediment/water interface.

In shallow areas, oil can be released from the sediments and rolled along the bottom by waves and currents, eventually to wash ashore to form hard, tarry masses or to rest offshore in the intertidal zone. Furthermore, beached oil can return to the sea as a result of storm wave action.

Based on information of Gulf Coast oil spillage, concentrations of spilled petroleum that reach coastal sediments are assumed to be degraded to background levels within 1-2 years (Brown, 1980; McAuliffe et al., 1975; Butler et al., 1976). Few long-term damage assessment studies of Gulf oil spills have ever been conducted; however, information known about the ultimate fate of spills that have occurred in the Gulf show rapid losses. In examining the 1970 Chevron, Main Pass Block 41 blowout, only 50% of the oil lost could be accounted for--25%-30% of the oil was estimated lost due to evaporation, 10%-20% of the oil was removed from the sea surface by skimming and other recovery techniques, less than 1% was believed dissolved in seawater, and less than 1% sunk and was deposited in the sediment within an 8 km radius of the well. Evidently, the remaining oil became emulsified and dispersed to undetectable levels (less than 1 ppm) or became biodegraded and/or photo-oxidized (McAuliffe et al., 1975). Dispersants were used in the cleanup operations and also in the water sprayed on the burning platform. Oil identified in nearshore sediments from this blowout showed rapid weathering after one week to one month, and at the end of one year was reduced to a few percent of the amount found immediately after the spill impact. Spilled oil was not found in the sediment below 4 cm. By six months beached oil from the same spill had been weathered to such an extent that just a slight trace of oil remained in Louisiana coastal sediments. In contrast, crude oil spilled in the Marquesas Keys, Florida, in 1975 was reduced to very low levels but still persisted after one year on rocky shore and mangrove-marsh substrates.

The majority of oil spills that have occurred in connection with oil industry operations in the Gulf have probably resulted in no serious long-term deleterious effects. This conclusion is based on the sparse documentation available on the historic effects of oil spills on the Gulf shoreline and on the rapidity with which Louisiana crude disperses and degrades.

Each spill is a unique event, with a number of factors interacting to determine its effects; and all spills occurring in the Gulf could be potentially harmful. The variability encountered in the literature on environmental effects of oil spills is due to differences in oil components, environmental conditions, and the organisms encountered. The most damage from an oil spill would occur when a spill from the open ocean reaches a confined shallow body of water where waterfowl or marine organisms are concentrated.

The ultimate impact and the recovery of an ecosystem from petroleum contamination depends on the physical and chemical form of the oil and the state of the ecosystem at the specific time of impact. The dispersion of oil in water, its movements, chemical modifications, effects on aquatic organisms, and persistence in the sea are all influenced by: (1) type and characteristics of the oil (for example, viscosity and percent aromatics); (2) amount and duration of oil spilled; (3) state of the sea, in particular the tidal cycle and wave activity; (4) location of the spill, including the physiography of the area and the distance from shore; (5) the geographical and topological configuration of the affected coast, including textural characteristics of shore sediments; (6) climatic conditions, in particular temperature, wind, and solar radiation; (7) biota of the area; (8) season of the spill; (9) previous exposure of the area to oil; (10) exposure to other pollutants; and (11) effectiveness of oil spill response measures taken by appropriate Federal and State agencies (Section IV.B.4.).

4. Oil Spill Containment and Cleanup Response

a. Contingency Planning

The development of contingency guidelines that serve as mechanisms for coordinating an effective response to oil spills has been addressed at all levels of government and private industry. Available oil spill cleanup equipment is of no use without a preplanned approach as to how to use it. Improvements in prespill contingency planning by government and industry in past years have increased the efficiency and effectiveness of cleanup response. By knowing the nature of the spilled oil, how the spill slick will move on the water surface, the threatened environment, and the available equipment and manpower, the responsible party can prioritize and evaluate selected actions.

When an oil spill occurs offshore, there is a network of existing contingency plans that are activated to provide response mechanisms for all levels of Federal, State, and local governments. Federal response in the Gulf is controlled by the Regional Contingency Plan (RCP), which was established under the auspicies of the Clean Water Act and its Amendments and the SuperFund Amendments and Reorganization Act of 1986. Two RCP's operate in the Gulf and are maintained by USCG Regions IV and VI. If the spill occurs in Gulf waters, coastal and offshore, the Coast Guard's Captains-of-the-Ports are designated the On-Scene Coordinators (OSC's) and control the Federal response protocol to the spill incidents. Each Captain-of-the-Port location has a local contingency plan that provides site-specific response mechanisms. Duties of the OSC include notifying the responsible party for the spill, encouraging the party to undertake proper countermeasures and to mitigate the effect, directing and monitoring cleanup progress, and providing advice and counsel to the spiller as necessary. In addition, there is a Regional Response Team (RRT) made up of various Federal, State, and local agency representatives. The RRT can be convened at the request of an OSC for advice or assistance in obtaining equipment or other support. At the national level, the National Response Team (NRT), comprised of representatives of 12 Federal agencies, is also available to an OSC for major policy decisions or large-scale and specialized support that is unavailable through RRT or local resources. Scientific Support Coordinators are provided by NOAA for coastal and offshore spills and are available upon the request of the OSC. This unique multi-agency working relationship gives the OSC quick access to equipment, personnel, and expertise needed during emergency situations.

The oil industry has its own contingency plans for responding to a spill. Both Clean Gulf Associates (CGA), a cooperative of oil industry companies operating in the OCS, and MIRG (the Marine Industry Group), representing the oil shipping industry, have extensive, detailed contingency plans.

Each CGA member is provided with an oil spill manual to assist them in the establishment of a comprehensive plan to prepare for a potential oil spill that might occur in the Gulf of Mexico. This manual indicates what procedures can be followed to make a timely response and helps in determining which cleanup/containment equipment can be used to the greatest advantage in responding to an oil spill so as to best protect the environment.

Pursuant to 30 CFR 250.42, all lessees in the Gulf of Mexico are required to submit an Oil Spill Contingency Plan (OSCP) for approval as part of the permitting process for any exploratory or development project before drilling may proceed. The OSCP outlines the lessee's decisionmaking process, reporting requirements, and methods/equipment that may be used for combating an oil spill. The CGA members often reference the Clean Gulf Manuals for manpower and equipment availability, and other specifications.

Besides the Federal Government and private industry, there are contingency plans developed at the State and local authority levels. The States of Florida, Texas, and Mississippi have detailed oil and hazardous substance pollution contingency plans for their coastal areas. Although Alabama does not have a formal plan, the information in a document entitled *Sensitivity of Alabama Shoreline Habitats to Spilled Hydrocarbons* assists the State in contingency planning and decisionmaking at the time of the spill. The State of Louisiana is presently developing a set of criteria that defines and establishes a process for responding in the event of a spill.

The U.S. Coast Guard (OSC's) has the ultimate responsibility to ensure that any oil spill incident occurring in U.S. waters is effectively cleaned up (Section I.B.4.). The OSC can oversee any spill response activity undertaken in coastal or offshore waters but usually acts, in the case of OCS industry spills, only if the spill is major. In the event that the discharger is unknown or incapable of organizing an adequate cleanup, the operator fails to cleanup, or private, State, or local authority cleanup activities are inadequate, the U.S. Coast Guard takes charge.

b. Equipment Response

Oil spill containment/cleanup operations are major tasks requiring significant coordination and cooperation, the transportation of large equipment, vessel support, aircraft support, the set up and maintenance of a command/coordination post in the field, and properly staged and available equipment. Often the weather/sea conditions and crew fatigue became critical factors to the success of these operations.

Training

Containment and cleanup operations are labor intensive due to the complexity of the environment they are conducted in and the constant monitoring/planning efforts associated with these types of operations. It is therefore essential that personnel be well trained in the use of the equipment and in the methodology of spill containment and cleanup. The MMS addresses this training by requiring through regulation (30 CFR 250.43) that the lessee ensures that the oil spill response operating team is provided with annual hands-on training classes in the deployment and operation of pollution-control equipment. Those responsible for supervising the oil spill response operations are required to be trained in directing the deployment and the use of all response equipment. Additionally, drills for familiarization with pollution-control equipment and operational procedures are required to be held when the equipment is placed initially and thereafter on an annual basis by the lessee or his contractor.

Equipment Types and Effectiveness

A wide variety of equipment is available to aid in the containment and cleanup of spilled oil. Some general categories of oil spill cleanup and containment devices include booms, skimmers, pumps, and sorbents.

Oil spill control booms are floating barriers designed to contain spilled oil for recovery, to divert oil to areas where recovery is easily carried out, and to act as a barrier in pathways to areas containing commercially valuable or environmentally sensitive resources. Boom designs vary considerably but all normally incorporate the following features: freeboard to prevent or reduce splashover; subsurface skirt to prevent or reduce the escape of oil under the boom; flotation by air or some buoyant material; and longitudinal tension member (chain or wire) to withstand the effects of winds, waves, and currents. The length and size of boom sections are important considerations, The optimum size of a boom is largely related to the sea state under which it is used. As a general rule, the minimum height of freeboard to prevent oil splashover should be selected and the depth of the skirt should be of similar dimensions. Short section lengths of boom are easier to handle and can protect the integrity of the boom as a whole, should one section fail; however, this should be weighed against the difficulty of connecting the sections effectively. Boom is typically constructed of modern lightweight/high-impact materials (high strength to weight ratio) and packaged compactly to allow for ease in transportation and deployment. Boom generally cannot contain oil against water velocities much in excess of 1 knot (kn) (0.5 m/s) acting at right angles to it. The escape velocity for most booms is around 0.7 kn (0.35 m/s), irrespective of skirt depth (Oil Spill Intelligence Report, 1984a).

Skimmers are mechanical devices designed to collect spilled oil from the water surface for disposal without chemically or physically altering the oil. Skimmers are classified on the basis of their operating principles into the following major groups: weir skimmers (provide gravity drain off to oil); vacuum skimmers (similar to weir, but utilize a power source to actively remove the oil); centrifugal skimmers (where a power source is used to create a vortex that drains the oil into collection); submersion skimmers (force the oil below the water level and use its buoyant property in the collection process); and oleophilic skimmers (collect oil on a moving sorbent material and mechanically squeeze it into collection areas) (Oil Spill Intelligence Report, 1988b).

Each of these skimmer types has its advantages and disadvantages, although the efficiency of each model will depend on several parameters, including oil thickness, oil viscosity, sea state, and storage capability. Each type of skimmer is best suited for a particular situation; no skimmer is effective in all conditions. In addition, since the skimmer is part of a system involving the containment and recovery of the spilled oil, as well as the separation of the oil/water mixture and the transportation of that mixture to receptacles, the overall efficiency of a skimmer is dependent upon the effectiveness of the individual components of the system (Oil Spill Intelligence Report, 1988b).

Pumps are used in oil spill cleanup operations to transfer collected oil from a collecting device, such as a boom, to a vessel or facility for separation, reprocessing, storage, or transportation to other facilities. Although specifications of the various pumps available are not relevant to this discussion, it should be recognized that pumps are necessary for cleanup operations.

Sorbents are those materials that recover oil by either absorption or adsorption. In absorption, oil penetrates the solid structure of the absorbents' fibers or particles, which then swell in size to accommodate the oil. In adsorption, oil adheres to the surface of the adsorbent material but does not penetrate the fibers or particles themselves. Sorbent materials are generally classified by their composition: (1) natural organic products, such as hay, peat moss, straw, or wood pulp; (2) mineral compounds, such as ash, perlite, or vermiculite; and (3) synthetic products, such as polyethylene, polypropylene, or polystyrene. Sorbents are usually marketed in particulate form or as boom, pillows, rolls, or sheets. Synthetic products are generally preferred over natural sorbents as they are able to sorb more oil while taking on less water. For this reason they take up less storage space and pose less of a disposal problem (Oil Spill Intelligence Report, 1988c).

As previously stated, winds and sea state have a significant effect on the performance of the aforementioned oil spill equipment. In general, 15-20 kn are the maximum wind speeds for dynamic upwind recovery, and recovery over sea state 3-4 is essentially undocumented (Tennyson, 1988). Of additional importance is the period of the waves. When an increase in winds produces short-period, localized seas, the efficiency of oil spill containment/cleanup devices decreases as the equipment tends to get swamped in the wash of these choppy waves. Large rolling waves (long period) present less problems due to the ability of the equipment to follow the waves' contours (Oil Spill Intelligence Report, 1988b).

Initial response to an oil spill occurring due to OCS oil development activities is available through equipment owned by CGA. Open ocean equipment available through CGA includes Fast Response Systems (FRS) and the High Volume Open Sea Skimmer System (HOSS) barge. The FRS is essentially a vessel of opportunity skimming system (VOSS) in that it is designed to be loaded onto a single vessel supplied by the lessee. Vessel length can range from 65 to 100 ft. Fast Response Systems are staged at onshore locations throughout the Gulf as indicated by Table IV-11. Once a FRS Unit is loaded onto a vessel, the vessel is generally capable of a 10-15 kn response dependent upon the size vessel utilized. Clean Gulf Associates' FRS consists of a barrier (two sections of 24-ft lengths of 48-in boom) connected to a weir skimmer and towed alongside a single vessel with an outrigger, an oil-water separator system, and recovered oil storage capacity.

Due to the problems of equipment and manpower coordination inherent in an oil spill response, skimming systems deployed from single, independent vessels are an attractive means of recovering spilled oil offshore. Whereas a large sweep system is advantageous on large unified slicks, a vessel of opportunity skimming system can be deployed more quickly, is more maneuverable (for skimming windrows of oil, for example) and requires only one vessel (Crocker, 1985). Operations of single-vessel systems are presently limited by the deployment and retrieval of the skimming system in rough conditions rather than by barrier performance in waves (Crocker, 1985). The CGA reports that the FRS weir skimmer will pick up essentially all the slick presented to it at boat speeds of 3/4 to 1 1/4 kn in seas up to 2 ft. As seas pick up and/or boat speed increases, however, effectiveness of the system decreases somewhat.

The HOSS barge located in Grand Isle, Louisiana, consists of a skimming system built into a specially designed 174-ft barge. Boom (1,000 ft total) is stored on two sides of the barge and is launched off the barge stern by means of a trolley running down ramps cut into the hull. Mounted in slots in the barges' stern are four leophilic belt skimmers, each followed by a weir skimmer. The HOSS barge is designed to be utilized to skim extensive long-duration spills where chasing after slicks is not required and to provide offshore operational support for spill recovery. This system must be towed by barge to an oil spill site. Tow speed is typically 4-7 kn. The HOSS barge is capable of working in up to 6-ft waves with boom and 7-ft waves without boom.

Lengths of 36-in nearshore containment booms, self-propelled skimming vessels, hand skimming systems, floating suction oil skimmers for use in shallow water, and sorbents make up a portion of the remaining inventory available through CGA. A complete listing of CGA equipment and its location is provided in Tables IV-11 and IV-12.

Since oil spill cleanup technology is constantly changing, new equipment and methods for oil spill containment and cleanup are constantly being evaluated. Clean Gulf Associates has recently informed MMS of their intent to initiate a study to assess their current cleanup capabilities. It is estimated by CGA that this project will take at least one year to complete. This action by CGA continues the ongoing effort to ensure that state-of-the-art equipment is maintained in the Gulf of Mexico.

Table IV-11

Number of Oil Spill Cleanup Contractors by State Stocking Various Cleanup Equipment

	Offshore Booms	Coastal Booms	Offshore Skimmers	Inshore Skimmers	Sorbents	Surface Collecting Agents	Chemical Dispersents	Bird Care Equipment
Texas	2	7	0	12	13	2	3	1
Louisiana	4	12	13	12	9	1	0	0
Mississippi	1	0	0	1	1	1	0	0
Alabama	3	6	1	5	2	0	0	0

Source: Marine Industry Group. 1988.

Table IV-12

CGA's Oil Response Equipment[1]

	Offshore Booms	Coastal Booms	Offshore Skimmers	Inshore Skimmers	Sorbents	Surface Collecting Agents	Chemical Dispersants	Bird Care Equipment
Texas								
Galveston		x	x		x	x	x	x
Port Aransas		x	x		x	x	x	x
Louisiana								
Cameron			x					
Intracoastal City		x	x		x	x		x
Houma				x			x	
Grand Isle[2]		x	x	x	x	x	x	x
Venice		x	x	x	x	x		x
Alabama								
Theodore			x					
Florida								
Panama City[3]			x		x	x	x	x

[1] As of November 1988.

[2] Main base.

[3] When there is a drilling activity in the EPA, equipment is strategically located at nearby offshore staging bases; for example, Panama City. When there is no EPA drilling, the equipment is stored in Houma, LA.

Equipment Locations

Cleanup equipment is maintained and utilized by the following operatives: (a) private contractors, defined as firms offering their cleanup services to other groups purchasing cleanup activity; (b) cooperatives, such as CGA, which is a group of firms that have entered into an agreement to form an organized cleanup service in the event that any of the members have a spill (Each firm has pieces of equipment that are stored together at operation bases and are made accessible to each other.); (c) private groups maintaining their own equipment in case a spill should result from an in-house activity; and (d) Federal, State, or local authorities.

The primary response to an oil spill occurrence due to OCS oil development operations is available through equipment owned by CGA. The principal purpose of CGA is to acquire and provide state-of-the-art oil spill recovery and cleanup equipment for the use of member companies. The CGA equipment is also available to non-members for a scheduled fee. A description of some of the specialized equipment maintained by CGA was discussed previously under "Types of Equipment." Table IV-12 identifies types of equipment stockpiled at CGA bases (as of November 1988). Other types of equipment maintained at each base include boat and helicopter spray systems, communications equipment, and oil storage barges. Other CGA bases where equipment can be stored but do not currently have equipment stockpiled include Rockport, Corpus Christi, and Fulton, Texas; and Harvey, Marrero, and Metairie, Louisiana.

Other oil spill cleanup/containment response capability is available at locations throughout the Gulf through independent spill cleanup contractors. The number of companies having various pieces of available equipment is indicated by State in Table IV-11. Besides equipment operated by numerous contractors, often coastal booms and skimmers are housed near refineries and other oil and chemical industry operations to respond to spills that may occur from their own facilities. For example, there are 16 oil company facilities owning coastal booms in Texas.

In addition to the services and/or equipment available to a lessee from CGA and independent oil spill contractors, the U.S. Coast Guard can initiate their own cleanup effort. There are eight U.S. Coast Guard Captain-of-the-Port/Marine Safety Offices based along the Gulf Coast that provide the OSC's. They may utilize their own capabilities or hire private oil spill contractors to cleanup and contain the spill. In the Gulf, the OSC's can also call upon the Atlantic Strike Team, based in Mobile, Alabama, to respond, particularly if the spill is a major event.

Besides the usage of cleanup crews by the oil industry and government, scientific support is often needed to effectively ensure proper protection of environmental resources, such as during placement of containment equipment. The NOAA officially acts as the Scientific Support Coordinator for the OSC.

c. Dispersant Usage Response

Chemical dispersants may potentially be used as an oil spill mitigation tool. Tables IV-11 and IV-12 delineate locations presently stockpiling dispersants in the Gulf of Mexico. Dispersant formulations have changed since the *Torrey Canyon* spill in attempts to develop more effective and less toxic products. These so-called second generation dispersants, introduced in the late 1970's, are being manufactured today. Therefore, only the current (late 1970's to the present) literature on effects of dispersed oil is relevant. Some studies have investigated the toxicity of dispersants alone (Wells, 1984). Studies that have considered species indigenous to the Gulf of Mexico, such as mangroves, seagrasses, and corals, include those by Baca and Getter (1984), Getter and Baca (1984), Getter and Ballou (1985), Teas et al. (1986), and Thorhaug et al. (1986). It is not clear that these results can be generalized.

Thorhaug et al. (1986), studying seagrasses, found *Thalassia* to be more tolerant of dispersed oil and oil alone than *Halodule* or *Syringodium*. Dispersant alone had significant impacts on *Halodule* and *Syringodium*, but not on *Thalassia*. Thorhaug et al. (1986) cautioned that the high concentrations used in the bioassays do not reflect actual field dispersant application conditions and, field testing of their results is necessary. Baca and Getter (1984) reported that the water soluble fraction of Prudhoe Bay crude oil was more toxic to *Thalassia testudinum* than dispersed oil or dispersant alone.

Getter and Ballou (1985) conducted field experiments to determine the effects of Prudhoe Bay crude oil and dispersant on red mangroves. They reported that undispersed oil caused lower survival and growth of seedlings, and lower growth and foliage cover of adult plants than did dispersed oil. Teas et al. (1986) found no difference in *Rhizophora* mortality from the controls in field experiments using dispersed oil. However, they found significant mortality when *Rhizophora* was treated with oil alone.

The key components of chemical dispersants are surface active agents (surfactants) which are molecules that have both water-soluble (hydrophilic) and oil-soluble (hydrophobic) ends. These molecules, when applied to an oil spill, orient themselves at the oil/water interface such that the hydrophilic ends of the molecules are in the water and the hydrophobic ends are in the oil. The result is a reduction of interfacial tension between the oil and water. This action reduces the cohesiveness of the oil slick and, with agitation, finely dispersed oil droplets (ranging in size, depending on the effectiveness of the surfactant formulation, from about 10 microns to 0.5 mm in diameter) are formed in the near-surface water. The hydrophilic surfactant groups prevent droplet recoalescence.

The decision to use dispersants must be made soon after the spill occurs. Weathering of oil will increase the viscosity and decrease the capability of chemically dispersing the oil. Factors to be considered in making this decision are oil type and properties, environmental conditions, the availability of dispersant and application equipment, and the probable fate of the oil without treatment. Highly viscous oils (greater than 5,000 centistokes), oils with pour points near or above ambient temperature, and oils with a high wax or asphaltene content may not be amenable to dispersant treatment (International Tanker Owners Pollution Federation, Ltd., 1982; Canevari, 1985). Dispersants are not recommended for use on spills on very calm waters. Some dispersants are formulated for use on marine (salt water) spills only.

Dispersants may be applied by boat or aircraft. Boat application is limited to small spills or those within a few miles of shore. Aerial spraying is the preferred method because it offers rapid response, coverage of large areas per unit of time, good control of treatment rates, optimum use of dispersants, and much better evaluation of treatment results than is possible from boats. Regardless of the method used, the application system must deliver the proper dosage of dispersant in a uniform spray of droplets to the slick. Most oil slicks considered for dispersion will be 0.25 mm thick, or less (a 0.25 mm thick slick contains over 4,000 bbls per square mile of oil). The dispersant must penetrate the oil to reach the oil/water interface. The proper dosage of dispersant (5 gal/acre is an average amount, depending on the dispersant and the oil types) must be used to attain the maximum reduction of interfacial tension. Finally, some form of energy, e.g., wind, wave, or mechanical, must be applied to the oil/water interface to cause the dispersion of oil into the upper part of the water column. Newer types of dispersants require very little mixing energy. (For a detailed discussion on dispersants, see Appendix D of Final EIS 104/105).

The National Research Council of the National Academy of Sciences is addressing the effects of dispersants in its review of the state of dispersants. This review is complete, but as of this writing, it has not been published. The Executive Summary, however, has been made available (National Research Council, 1988).

A computer program, to aid decisionmakers in determining whether or not to use dispersants under specific spill conditions, is being developed by the industry. When fully developed this program will track oil and dispersed oil under conditions prevailing at the spill site and will provide a comparison of the impacts of the two on biological resources of the area. It is expected that industry will use this program in their contingency planning and that State and Federal officials will use it during actual spills.

The MMS will examine toxicity of dispersed oil to important Gulf of Mexico species in a study contract to be awarded in 1989. Finally, LOOP, Inc. is conducting toxicity tests on postlarvae and/or juveniles of brown and white shrimp, blue crab, oyster, and red drum (Proceedings..., 1987).

An oil-treating agent called "Elastol," which is not a dispersant, aids in the containment and recovery aspects of oil spill cleanup. Elastol is a nontoxic powder that dissolves rapidly when dispensed on hydrocarbon liquids and modifies the oil giving it a viscoelastic property and making recovery more efficient. It is usable on light and heavy crudes, kerosene, diesel, gasoline, bunker, and many other hydrocarbons. In recent tests, the application of Elastol on offshore oil spills in 500-900 ppm quantities increased the performance of skimming equipment 2-5 times over untreated performance recovery rates. It also minimized oil spreading, streaking, and breakup due to wind and wave conditions of up to 15 knots. When used with booms it shows successful containment in currents over 1 knot. Additional information on Elastol can be obtained from a technical paper entitled *Laboratory and Tank Test Evaluation of Elastol*, which was presented at the "Tenth Arctic and Marine Oil Spill Program Technical Seminar" (Bobra et al., 1987).

C. ITEMS OF SPECIAL CONCERN

1. Geohazardous Conditions

Within the Gulf of Mexico major geohazards to oil and gas development are associated with seafloor geologic features that result in seafloor instability. These hazards present many operational limitations to the exploration and development of oil and gas. Seafloor instabilities present limitations and necessitate adaptations in the siting and structural engineering of pipelines, drilling rigs, and production platforms. Three conditions prevail in the Gulf of Mexico that cause unstable conditions on the seafloor: (a) salt movement, which may result in salt domes, faults, steep slopes, gas seepage, and sediment slumping; (b) sediment overloading and differential compaction causing growth faults and differential subsidence; and (c) rapid sedimentation in deltaic areas that results in unconsolidated, fine-grained, often gas-charged sediments.

Most structures and equipment used for minerals exploration and development can be designed to withstand the stresses of the continental shelf environment if adequate information is available. Studies developed under the former BLM Environmental Studies Program have been especially directed toward areas where more detailed geologic information was needed for intelligent management of the OCS mineral leasing program. Visuals Nos. 6 and 6E show the areas where geologic studies have provided detailed information and mapping.

For greater detail of potential geohazards existing within areas of the Gulf of Mexico, see Volume 1, Section III.A.1.j. of the Final Regional EIS.

Under the schedule for oil and gas leasing, the offering of all blocks within the CPA and WPA does not allow for presale geohazard block evaluations as were previously done. Instead, the Secretary of the Interior has announced that geohazard surveying and evaluation will be done by industry. The Regional Director (RD) of MMS notifies the operator of the lease through NTL 83-3 that conditions may exist such that precautions in site selection and design must be taken. Thus, industry has the responsibility to interpret in detail and furnish the RD with the results of surveys for the blocks leased within the geohazardous areas. Subsequently, industry must indicate to the RD how plans of exploration and development minimize and/or avoid the geohazards that exist within the lease area. Geological and geophysical (G&G) activities authorized under 30 CFR 251 (for areas not under lease; G&G activities on leased acreage are under 30 CFR 250) must be conducted so that the activities permitted do not create hazardous or unsafe conditions. G&G activities provide data on potential geological and manmade hazards. Geophysical surveys conducted on a lease must be conducted in compliance with NTL 83-3, Shallow Hazards Requirements for the Gulf of Mexico OCS Region. Before the installation of any structure or pipeline, the grantee shall conduct a shallow hazard analysis in the immediate area of the proposed activity to locate, identify, and assess the potential geologic hazards and engineering constraints that may be present.

In essence, a shallow hazards analysis shall include the following:

- An assessment of any seafloor and subsurface geologic and manmade features and conditions that may have an adverse effect on the proposed operations. Seafloor geologic hazards include fault scarps, gas vents, unstable slopes, and reefs. Subsurface geologic hazards include faults, gas-charges sediments, abnormal pressure zones, and buried channels. Manmade hazards include pipelines, wellheads, shipwrecks, ordnances, communication cables, and debris from previous oil and gas activities.

- A specific discussion of sediment mass movement, unstable slopes, active faulting, or gaseous sediments when required by the special operational constraints on some leases.

- A discussion of any special safety measures that would minimize the effects of shallow hazards on the proposed pipeline including a discussion of how compliance with provisions of NTL 83-3, section IV, paragraph B, will be accomplished.

Under the postsale regulatory authority of MMS, the lessee is required to obtain detailed site-specific geologic hazards information (including soils borings in special cases) at locations on leased blocks where pipeline development is proposed. This requirement is imposed on all lessees to assure safety of operations before approval of pipeline permits. The extent and degree of geologic hazards investigation required of the lessee is at the discretion of the RD, who is charged with approval of the safety of OCS operations. The general procedures to be followed by the lessee in conducting the site-specific geologic hazards survey are set forth in NTL 83-3 issued by MMS. The NTL and applicable letters to the lessee serve as guidance for minimum requirements and in no way restrict the authority of the RD to impose additional requirements on the lessee when necessary. As a result of revised regulations contained in 30 CFR 250, effective May 31, 1988, MMS is currently revising NTL 83-3.

2. Ordnance Disposal

The Department of Defense (DOD) explosives dumping areas found in the Gulf planning areas are shown on Figures IV-5 and IV-6 in Final EIS 113/115/116 and are hereby incorporated by reference. Most of the small areas contain a single, undetonated depth charge. For the large areas shown, dumping consisted of old ordnance and unexploded (duds) shells and depth charges. No dumping has taken place in any of the explosive areas since 1969-1970. However, all lessees should take precautions in drilling and locating structures within or near these areas due to the presence of unexploded ordnances. The U.S. Air Force (USAF) has released an indeterminable amount of unexploded ordnance in water test areas 1 and 3 as a result of testing and training missions. The exact locations of this unexploded ordnance cannot be determined and all lessees in the Gulf should take precautions in drilling or locating structures due to the potential hazards. In past sales this warning has been provided to each lessee in an ITL.

3. Blowouts

During OCS oil and gas operations, blowouts--the loss of well control--are the incidents that are most feared and have the greatest potential for causing deaths, injuries, property damage or loss, and pollution. However, well blowouts and platform or drilling rig losses are rare occurrences during offshore drilling operations.

Gas pressure can be responsible for a well blowout. Very shallow gas may occur in unconsolidated sediments at depths of 100-500 ft below the mud line. Drilling through these shallow gas zones requires extreme caution. A delicate balance between drilling-mud pressure and formation pressure is necessary to prevent an influx of gas into the wellbore and to avoid fracturing the near-surface formations. Shallow gas and formation fracturing are an even greater potential hazard in deep waters because it is more difficult to keep in proper balance with the ocean water and overburden pressures.

When a well blowout occurs, the loss of control could be momentary--and control could be immediately regained using standard onsite safety equipment and procedures--or it may continue for several days. The duration of blowouts that occurred in 1956 through 1986 ranged from immediate shut-in to 165 days. The amount of pollution per blowout ranges from 1 to 64 bbls (Table IV-26 of Final EIS 110/112). The amount of gas escaping during a blowout is difficult to determine. In the Gulf of Mexico, no identifiable environmental damage was caused by blowouts from 1956 to 1986 with the exception of a blowout that occurred in 1970 and resulted in the spillage of 53,000 bbls of oil. Minor amounts of oil were observed on beaches as a result of this accident (USDI, MMS, 1986b and 1987b).

Industrial expertise in safety has increased as industry has advanced drilling technology. The MMS is supporting studies on blowout prevention, blowout fire suppression, and the collection of blowout oil before it disperses into the open ocean. An important factor in ensuring that offshore oil and gas operations are carried out in a manner which emphasizes safety of operations and minimizes the risk of environmental damage is the proper training of personnel in pollution prevention procedures. The enacted Safety Device Training Program requires all personnel to receive training for the installation, testing, inspection, and operation of production, safety, and pollution prevention equipment. The Drilling Well-Control Training Program instituted by MMS in 1979 requires all personnel involved in offshore drilling activities to be trained in well control operations and requires periodic refresher courses.

D. ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTIONS AND ALTERNATIVES

1. Central Gulf Sale 123

a. Impacts from Alternative A - The Proposed Action

(1) Impacts on Sensitive Coastal Habitats

The major impact producing factors that could potentially affect sensitive coastal habitats are oil spills, pipeline emplacement, construction of onshore support facilities, construction of navigation canals, and maintenance dredging. The five levels of impact used in the analyses and conclusions are defined in Table S-4.

(a) Coastal Barriers

Barriers are inherently mobile landforms. For the purposes of this analysis, only changes that result in a reduction in the extent or size of the landform or one of its component environments will be considered an impact. Under natural conditions, barriers can continually adjust their plan and profile configurations in response to changing environmental conditions. Therefore, changes in the location or configuration of a landform that are not accompanied by a change in the extent of the landform will not be considered an impact. Rather, these changes are considered aspects of the natural behavior of the landscape.

Four factors have the most direct impact on changes in barrier landforms. An OCS activity that affects one of these factors or the way that a barrier feature responds to one of these factors could have an impact on a barrier landform. These four factors are discussed below.

Sand Supply and Distribution

In many cases, barrier landforms require a steady supply of sand in order to maintain their stability. Sand is needed to replace the sediments that are removed from the beach and transported either onto the continental shelf or across the island into the lagoon during storm events. Human activities have modified the sand budgets of many coastal barriers. Along the Gulf Coast, the upstream damming of the Mississippi River and its major tributaries (especially the Missouri River) has reduced the amount of suspended sediment that is transported to the coast by over 50%. There has been no direct measurement of the changes in the bed load discharge. Channelization of the lower Mississippi River has cut off sediment sources to the coast through distributary channels such as Bayou Lafourche. Groins and jetties that have been installed perpendicular to the shore to stabilize beaches and harbor entrances at passes through barrier islands can interfere with longshore drift patterns and deprive updrift coastal areas of needed sediment. Sand can be removed from a beach as a result of oil spill cleanup procedures.

Sea Level Rise

Bruun (1962) formulated that a barrier landform will migrate landward 2-3 orders of magnitude times the amount of vertical sea level rise along a coast with a gently sloping continental shelf. Numerous investigators have documented the validity of this principle. The ongoing eustatic sea level rise combined with geologic subsidence therefore contribute to the migratory behavior of barrier landforms in the Gulf of Mexico. This migration, however, will not necessarily result in the erosion of the landform because the entire form can move with no significant change in shape. If a barrier island is developed, however, and efforts are made to fix the location of the island to protect the structures built on it (roads, utility lines, marinas, offshore support bases, etc.), the island cannot migrate in response to rising sea levels and it will erode. Although OCS activities have no direct affect on relative sea level rise, the location of OCS-related support and processing facilities on barrier features can indirectly lead to impacts associated with sea level changes because of the island stabilization structures needed to protect the facilities.

Energy Regime

A change in any climatic variable that affects the energy impinging on a barrier landform (waves, nearshore currents, winds) can alter the barrier landscape. A climatic change that would affect barrier stability, however, would take place gradually over a long time period and need not be considered in the current analysis.

Vegetation

Sand dunes can be destabilized by weakening or destroying the vegetation that anchors the dunes in place. Vegetation can be affected by vehicle traffic or by an oil spill that is carried onto the dunes by a storm tide.

Base Case Analysis

The major impact producing factors associated with OCS activities in the Central Gulf of Mexico that could potentially affect barrier landforms include pipeline emplacements, support infrastructure construction, navigation canal construction and maintenance, oil spills, and OCS trash and debris. The latter topic is discussed in Section IV.D.1.a.(9).

All pipelines that will be constructed to serve leases that result from the proposed action are expected to tie into existing trunk lines for transportation of the product to shore. Therefore, there should be no pipeline emplacement impacts to coastal barriers as a direct result of Sale 123. If, because of unexpected discoveries, the need arises for more pipelines to come ashore, strategic routing and proper emplacement techniques should serve to minimize impacts.

No new ancillary facilities or new navigation canals are expected to result from the proposed action (Table IV-1). Maintenance dredging of existing navigation canals, however, will occur periodically. Changes in channel configuration can alter the littoral dynamics of the nearshore environment, which could endanger the natural deposition of sand/sediment and the self maintenance of its features.

Oil spills present a variety of threats to coastal barriers. A primary concern with the severely eroding barrier beach network in Louisiana is the potential for the removal of beach sands during an oil spill cleanup. The actual levels of impact will vary depending on the volume of oil contacting a particular area, the time of year, and the water stages. The Alvenus tanker oil spill, which occurred in 1984, represents what probably would be a major spill event on a barrier beach originating from OCS production. The size of the spill (as much as 65,000 bbls) ranks it as one of the largest spills to have occurred in the Gulf. Of the 20 large oil spills (1,000 bbls or greater) that have occurred in the Gulf as a result of OCS oil and gas production, only two have exceeded the magnitude of the Alvenus spill. Furthermore, efforts to intercept the oil prior to its reaching the coast at Galveston Island were ineffective. Only 200 bbls, or 0.3% of the total spill, were captured. The impact of the Alvenus spill on a barrier island is unlikely to be exceeded by a future spill that results from OCS activities.

The greatest accumulation of oil from the Alvenus spill occurred on Middle and Western Galveston Island. Road graders were used to move beached oil above the high tide zone. In all, 90,000 yds^3 of sand was removed from the beach. This amount of sand removal was considered equivalent to the amount that would be removed by a minor storm (McKinna, 1985). By comparison, Hurricane Alicia, a major Gulf hurricane, removed 900,000 yds^3 of sand from Galveston beach. The beach profile changed slightly as a result of the sand removal project, but this change was undetectable after a few spring tides. Furthermore, not all of the sand scraped from the beach was removed from the island environment. Sand that contained less than 10% oil concentration was put in the nontidal beach zone or in the back beach adjacent to sand dunes. Investigations at other oil spill sites have shown that much of the sand that is affected by oil can be cleaned and salvaged by appropriate sifting techniques (Gassman and Gunkel, 1983). If a similar event occurred as a result of Sale 123, the expected impact on coastal barriers would be a short-term alteration of the beach profile as a result of cleanup operations nad perhaps damage to sand dune vegetaton from the machinery used during cleanup.

In the Central Gulf there are barrier systems in Terrebonne, Lafourche, Jefferson, and Plaquemines Parishes in Louisiana and along the Mississippi and Alabama coasts that are exposed and highly vulnerable to potential oil spills resulting from the proposed action. As noted in Table IV-7, the OSRA model indicates a very low percent chance (less than 0.5% to 3%) of a large oil spill occurring and contacting barrier beaches within the CPA. Furthermore, no spills of > 50 and < 1,000 bbls will contact the coastline during the 34 year lease life (Section

IV.B.2.). Although a few smalls spills > 1 and ≤ 50 bbls are assumed to contact the coastline, beach clean-up activities could gather much of the oil in a short time from a small spill.

Conclusion

Impacts of the proposed action on coastal barriers in the CPA are expected to be very low because of the lack of any new construction of pipelines or facilities and the minimal probabilities of a large oil spill contact.

Cumulative Analysis

Specific impact producing factors that are considered in the analysis include sediment reduction, pipeline landfalls, navigation canals and facilities impacts, oil spills, beach protection and stabilization projects, recreational activities, land use, and tropical storms.

As discussed in Section III.B.1.b., the condition of barrier islands in coastal Louisiana is related to the constructional versus the destructional stage of the nearby deltaic landmass. The Mississippi River is also a direct source of sand-size sediment to coastal landforms. The suspended sediment load of the Mississippi River has decreased over 50% since the 1950's, largely as a result of dam and reservoir construction upstream within the drainage basin (Tuttle and Combe, 1981; Turner and Cahoon, 1988). While the dams that have been constructed within the Mississippi drainage system also effectively trap sand-size sediment, the bed load of the lower reaches of the Mississippi River has not necessarily decreased as a result. The River, in response to a lowered sediment load, may have entrenched into its bed deposits and transported these materials into the Gulf. Turner and Cahoon (1988) have made the most detailed study of recent changes in the bed load of the lower Mississippi and have concluded that upstream of New Orleans the River has aggraded its bed, presumably with sand that has been eroded from the bed deposits located upstream. Below New Orleans, it appears that sediment is being carried downstream directly to the Gulf without any intervening channel storage. It is not known, however, how this bed load discharge compares in magnitude to earlier pre-dam construction discharges.

Channelization of the Mississippi River for flood control and navigation has also affected sand delivery to coastal landforms in Louisiana. Today, sediment from the River is discharged to the coast only through the main channel of the River and the Atchafalaya River system. In prechannelization times, the flow of the River was distributed among several distributary channels, which would have provided sediment inputs to the coast over a broad area during high river stages. Furthermore, the modern birdsfoot channel of the River has prograded so far out onto the continental shelf that much of the River's coarse sediment load is deposited in deep water and thereby lost to the coastal littoral system.

The barrier landforms to the east of the Mississippi River delta in the CPA are not dependent on a fluvial source of sand. Rather, these islands appear to be nourished by the sandy barrier platforms beneath them (Oetvos, 1980). These nearshore sand bodies provide sand nourishment through littoral current processes.

To summarize, alterations of the flow regime of the Mississippi River will continue to have a significant impact on coastal landforms in Louisiana. To the east in Mississippi and Alabama, barrier landforms are not dependent on a fluvial source of sediment.

Pipeline landfalls can affect barrier landforms in several ways. If the pipeline cut is not regraded to its original contour or if it is not revegetated, the landfall right-of-way can be an area of weakness that will erode or be washed over during storm conditions. Also, if the nearshore bottom topography is altered where the pipeline makes landfall, refraction patterns can change and possibly concentrate wave energy and encourage accelerated erosion at the landfall location. An ongoing MMS study, *Impacts of OCS Related Activities on Sensitive Coastal Habitats*, is investigating the full range of pipeline emplacement impacts on barrier landforms in the Gulf. The results of this study should be available for analysis for Final EIS 123/125. A total of 241 pipelines have made landfall in the CPA. Many of these landfalls have occurred on barrier features. The impacts from these landfalls may have been large, particularly during the early years of the OCS program when environmental knowledge and regulations were rudimentary.

The addition of up to two new pipeline landfalls are assumed to result from future and prior OCS sales in the CPA. Current environmental regulations and pipeline emplacement techniques are sufficient for minimizing impacts from future pipeline projects. A 4" oil pipeline, for example, was installed across Timbalier Island, Louisiana, in 1984. As a condition of the permit, the trench could at no one time be completely open across the island (LeBlanc, 1985). This construction procedure was required in the event that a storm occurred prior to the completion and backfilling of the pipeline project. An open channel across the island could have severely eroded and even breached the island during a storm. Another permit requirement was that the pipeline route had to be revegetated after construction. Monitoring the revegetation and environmental change along the pipeline route since its installation in November 1984 indicates that revegetation and stabilization of the trench was rapid and occurred with no significant impact to the landform. The wetland areas in back of the island were the only areas that did not show rapid revegetation (Mendelssohn and Hester, 1988). This project shows that additional pipeline landfalls can be accommodated with little impact to barrier environments.

The construction and maintenance of navigation canals through barrier island passes can have impacts on the surrounding landscape. Stabilization of these channels with jetties can interfere with longshore sediment transport, resulting in the accumulation of sediments on the updrift side of the jetty and erosion on the downdrift side. Penland and Boyd (1982) have recommended that a sediment bypassing system should be employed around jetties in coastal Louisiana to eliminate this problem. The maintenance of dredged channels in these passes can alter coastal hydrodynamic processes such that net landward water movements through the channel can occur. Under these conditions the channels act as sediment sinks, removing littoral sediments from the longshore transport system. Although no new navigation canals are expected to result from the proposed action, the ongoing impact from existing channels is likely to affect barrier landforms in the CPA. Few, if any, new navigation canals are expected to be installed during the next 34 years for other purposes. The bases of this assumption are that the large number of existing navigation canals can accommodate further navigation needs and that current concerns about barrier island erosion and possible canal impacts on erosion will not favor permitting new canal projects. Future OCS leasing activities, however, in deeper waters may utilize tankering rather than pipelines to bring the product to shore. This trend may require dredging work in existing channels to accommodate the increased vessel traffic. Channel modifications could affect the sedimentology of the channels and long-shore sediment transport processes.

As indicated in Table IV-7, the chance of contact from the occurrence of one or more oil spills resulting from the proposed action, prior and future OCS leasing, and Federal OCS and crude oil imports by tankering range from 21% for the Gulf Islands National Seashore beaches in Mississippi to 81% for the West Plaquemines coastal barrier. It is therefore likely that a large spill will occur. A few spills less than 1,000 bbls are likely to occur each year close to the coastal environment. Based on the analysis of the Alvenus spill, even a large spill (1,000 bbls or greater) will probably have only a minor influence on the long-term evolution of Gulf coastal barriers.

Efforts to stabilize the Gulf shoreline have had impacts on barrier landscapes. There are two approaches to beach protection and shoreline stabilization: rigid structures, such as jetties and groins, and nonrigid techniques, such as beach nourishment. Rigid approaches include devices to trap longshore sediments and structures to prevent erosion of the shoreline. Groins, jetties, seawalls, and other engineering structures are designed to impede natural ocean forces and sand transport and to mitigate oceanic forces acting on the beach during storm conditions. Rigid engineering structures have often produced poor, and in some cases, deleterious results. Large amounts of money have been spent on structures to save the beach, but many are ineffective and some have aggravated existing problems. These structures have finite lives, are expensive to construct and maintain, and commonly transfer the erosion problem elsewhere by locally eliminating or reducing the sediment supply.

Structures that are constructed to stabilize the beach by fixing its location expose the landform to the erosive effects of a rising relative sea-level rise. Under natural conditions, barrier landforms will assume a low, streamlined profile in response to erosive wave attack and will migrate landward in response to inundation and erosion associated with a rising sea level. Fixing the shoreline causes a rising sea level to pile sediments against the shoreline, creating a steep berm-dune complex that is subject to wave attack. In some stabilized coastal areas, the entire beach has eroded away, leaving the seawall or duneline exposed to the direct attack of waves.

Dolan (1972) have suggested that dune stabilization programs that transplant vegetation to barren dune areas and that install snow fences to trap migrating sand may actually be encouraging erosion. The stabilized duneline may be functioning as a seawall by fixing the island in one location and keeping the landform from reconfiguring its profile when under storm attack. Mendelssohn (1982) reports, however, that dune stabilization projects throughout the United States have had positive impacts on beach stabilization and development, and that the use of vegetation for dune building and stabilization in Louisiana is an effective and cost-efficient erosion control method that is compatible with natural coastal processes. The continued use of dune stabilization progress as a means of protecting the Louisiana coastline has received strong support from coastal scientists (Penland and Suter, 1988).

The feasibility of mining offshore sand bodies for beach nourishment is being investigated in Louisiana. Sufficient quantities of sand occur within an economic distance to the coast. Preliminary estimates indicate that sand nourishment of barrier beaches from offshore sand sources may be a cost-effective approach for stabilizing the Louisiana coast (Penland and Suter, 1987).

Most barrier beaches in Louisiana and Mississippi are relatively inaccessible for recreational users either because they are located at a substantial distance offshore, as in Mississippi, or in coastal areas with limited road access, such as in Louisiana. Few beaches have been, or are likely to be in the future, substantially altered for construction projects to accommodate recreational users. Also, damage to dune vegetation and other sensitive beach areas from recreational users, such as dune buggy operators or hikers, has not been, and will not likely be in the future, significant in most cases.

Under natural conditions, with a continuous supply of sand being delivered to different parts of coastal Louisiana by the Mississippi River system, the impacts of large storms and hurricanes on barrier landforms located near prograding parts of the coast would be only temporary. Sediment eroding from beach areas during the storm would be restored when calm conditions prevailed. Today, with all parts of coastal Louisiana experiencing sediment deprivation, the impacts of tropical storms on barrier landforms can be permanent.

In 1985, for example, three hurricanes severely damaged Louisiana's coastal barrier systems and shorelines. Hurricane Danny (August 1985) eroded approximately 10%-15% of the Isle Dernieres and cut several tidal channels through these islands. Beaches were eroded some 30-100 ft along these islands. Timbalier Island incurred similar damage to its shoreline. Grand Isle experienced erosion of 20-60 ft of beachfront. Hurricane Elena (September 1985) caused severe erosion and landloss along the Chandeleur Islands, where approximately 20% of the land area was lost. Elena eroded 25-80 ft of beachfront and breached the islands in several locations. Hurricane Juan (October-November 1985) caused the heaviest damage to the State's barriers and shorelines by making landfall and lingering off/on the Louisiana coast for three days, resulting in extensive landloss and loss of fish and wildlife habitat. Beaches eroded 40-100 ft along the entire coastline, with some areas experiencing a more extensive loss of beachfront. Channels through the barrier islands were widened and numerous new inlets were created (Louisiana Geological Survey, 1985).

Between 1880 and 1980 total coastal barrier area in Louisiana decreased by over 40%, or 0.4% per year (Penland and Boyd, 1982). These areal losses have probably not been uniform during the past century but have occurred more rapidly during recent decades when human impacts on barrier landforms have become more common. Current estimates of loss rates vary from about 3% per year for the Isles Dernieres to under 0.5% per year for the Chandeleur Islands (Penland and Suter, 1988). Impacts on barriers should continue because the impacting factors have not been mitigated. Although public concern over barrier erosion in Louisiana has increased dramatically in recent years, a program to reduce cumulative impacts to a less than very high level during the next few decades has not been formulated. Impacts on the barrier islands offshore Mississippi and Alabama will not be as large as they are in Louisiana.

Conclusion

The total level of impact to barrier landforms is expected to be very high in the CPA.

High Case Analysis

No new support infrastructure or navigation canals are expected to be constructed along the Central Gulf coastal area as a result of the proposed action (Table IV-1). Impacts from such activities would, therefore, be precluded. Some maintenance dredging of existing canals can be anticipated. Although the chances of contact to a barrier beach from a large oil spill increase as a result of the High Case (Table IV-7), the probability is still low and it is assumed that such a contact will not occur. A few spills > 1 and ≤ 50 bbls and one spill between > 50 and $<$ 1,000 bbls will likely occur and contact coastal barriers; however, these spills are unlikely to have an impact on barrier landforms, as discussed above.

Conclusion

The impacts of the proposed action under the High Case are expected to be very low.

(b) Wetlands

The wetlands considered in this analysis include forested wetlands, nonforested wetlands or tidal marshes, and mangroves (Visual No. 4). Impact producing factors that result from the proposed action that could adversely affect wetlands are oil spills, pipeline placements, canal dredging, and construction of onshore facilities in wetland areas (Sections IV.A.3. and IV.B.). Each of these factors is considered in the impact analysis, and an expected level of impact is estimated for each affected coastal subarea using the five levels of impact defined in Table S-4.

Base Case Analysis

The impacts of spilled oil on coastal marsh vegetation has been studied by a number of investigators in the Central Gulf coastal area. The length of time for marsh vegetation to recover if an oil spill should contact CPA wetlands, in the absence of continued stress, is believed to be short. The NAS (1985) estimates that recovery will occur within one generation, or one year, for some grass species. As an example, in 1985 a pipeline break released 300 bbls of oil into a 50-acre area of marsh in Louisiana. Although the immediate impact on the vegetation in the area near the spill was considerable, the vegetation was expected to recover within 1-2 years (Fischel, 1987). Other studies in the Gulf of Mexico area have indicated only minor to moderate damage from oil spills (Delaune et al., 1979; Lytle and Lytle, 1987). In these investigations, death occurred only to heavily oiled shoots of contacted marsh vegetation, and the vegetation recovered within one or two growing seasons. Alexander and Webb (1987) observed no affect on the growth of *Spartina alterniflora* from light oiling (less than 5 mg oil/g sediment) after a crude oil spill in Galveston Bay, Texas. Growth was significantly reduced in sediments with high oil content (5-51 mg/g), but this impact lasted through only 18 months. Shorelines with high oil concentrations experienced accelerated rates of erosion within 16 months of the spill occurrence. Accelerated erosion persisted for up to 32 months. The influence of oil spills on marsh erosion is of particular importance in coastal Louisiana, which is experiencing rapid rates of wetlands erosion and deterioration.

The response of marsh vegetation to an oiled environment also depends on the plant species that is being affected and the plant community structure. For some plants, growth stimulation occurred after oiling (Leenderste and Scholten, 1987). *Juncus roemerianus*, a common salt marsh plant found in the CPA and WPA, was found to take up hydrocarbons from contaminated water and sediment, and could remove oil from underlying sediments (Lytle and Lytle, 1987). In fact, uptake of oil from surrounding sediment, adsorption of oil on marsh vegetation, and the subsequent formation of oil-laden detritus has been observed to be a major transport and dispersion mechanism for spilled oil in the wetland setting (Milan and Whelan, 1978).

Large oil spills that occur offshore as a result of OCS production would experience a greater amount of wave and tidal motions prior to reaching the coast than would spills that originate closer to shore. These oceanic processes would tend to spread the spill along the coast and reduce the concentration of spilled oil that occurred at any one location. Furthermore, spilled OCS oil would likely contact coastal fringing marshes which contain a higher silt/clay to organic matter ratio than do more interior fresh marshes. Alexander and Webb (1987) suggest that marsh soils high in silt/clay were less likely to absorb oil. Oil absorbed into the soil acts to inhibit revegetation of the affected marsh. If a large spill or small spill greater than 50 bbls were to occur offshore and reach coastal wetlands, the level of impact is expected to be moderate. This determined level of impact is based on the fact that the greatest oiling would occur on coastal-fringing marshes. Much of the oil would spread out along the coast, would not penetrate into the higher silt/clay marsh soils of the fringing marsh, and would not result in heavy oiling. Some oil would reach interior marshes, resulting in 1% of the habitat being destroyed. Much of the contacted wetland would recover in 1-2 years.

As noted in Table IV-7 under the Base Case, the OSRA model indicates reasonably low chances (0.5%-6%) of a large spill occurring and contacting wetland areas in the CPA. The greatest chance of contact occurs in the Western Deltaic Plain wetlands in Louisiana (6%). Based on these low probabilities, it is assumed that a large spill occurring as the result of Sale 123 would not contact wetlands. No spill in the size class > 50 and < 1,000 bbls would contact the coastline, and only a few spills > 1 and $\leq$ 50 bbls are assumed to contact the coast during the 34-year lease life (Section IV.B.2.). Spills could occur from pipelines that traverse the marsh and carry OCS products, from shuttle tankers that are transporting crude oil to existing marine terminals, and from storage tanks that are located in wetland areas. Statistics for coastal spills are only available for large spills from shuttle tankers (Section IV.B.1.). There is a 0.01% probability that a large oil spill will occur while the vessel is approaching the Mississippi River ports in Louisiana (Section IV.B.1.b.).

Small chronic spills less than or equal to 50 bbls that occur as a result of the proposed action will add to the chronic petroleum contamination that exists in the coastal waters of the CPA (Section IV.B.2.). As discussed above, however, it appears that low levels of oil in the marsh substrate and in plant tissues have caused only small disturbances or have actually resulted in growth stimulation of the affected vegetation. Spills of 50 bbls or less are, therefore, not expected to result in significant impacts to wetlands in the CPA.

No construction of new oil/gas pipelines or service bases is anticipated for any of the Central coastal subareas as a result of the proposed action (Table IV-1). No new navigation canals are expected to result either. Maintenance dredging of existing navigation canals occurs periodically. The amount of dredging for sale-related activities are currently unavailable. Dredging, however, can have significant impacts on coastal wetlands as discussed further under cumulative impacts. Wave action generated by sale-related vessel traffic in navigation canals can also cause soil erosion and loss of wetlands.

Conclusion

The level of impact on coastal wetlands is expected to be low as a result of the proposed action.

Cumulative Analysis

This cumulative analysis considers the effects of impact producing factors related to the proposed action plus those related to the Western Gulf proposed action, prior and future OCS sales, State oil and gas activities, other governmental and private projects/activities, and pertinent natural processes and events that may occur and adversely affect wetlands. Specific types of impact producing factors that are considered in this analysis include sediment deprivation, submergence, canal construction, land development, and miscellaneous factors.

Wetlands loss has been and continues to be of concern in many areas of the Gulf Coast from Texas to Florida. In the Mississippi Deltaic and Chenier Plains of Louisiana the rate of wetlands loss is very high. Gagliano et al. (1981) estimated that the annual wetlands loss in 1980 on the Mississippi Deltaic Plain was 39.4 mi^2 (25,216 acres). The average annual loss rate on the Chenier Plain was estimated at 7.7 mi^2 (4,928 acres). The collective rate of wetlands loss for all of coastal Louisiana is currently estimated to be 50 mi^2 or more per year.

Many factors contribute to wetlands loss in the Central Gulf. In a coastal setting that is experiencing submergence, the marsh surface must accrete vertically to keep pace with the ongoing rate of relative sea level rise. Mineral sedimentation is needed to encourage this vertical accretion. In coastal Louisiana, the Mississippi River and its distributaries are the primary sources of alluvial sediments for coastal wetlands. The suspended sediment load of the Mississippi River has decreased nearly 60% since the 1950's, largely as a result of dam and reservoir construction upstream within the drainage basin (Tuttle and Combe, 1981; Turner and Cahoon, 1988). While the dams that have been constructed within the drainage basin also trap sand-size sediments, it is not clear whether or not the bed load of the Mississippi River has decreased as a result. The River, in response to a lowered sediment load, may have entrenched into its bed deposits and transported these materials into the Gulf. Turner and Cahoon (1988) have made the most detailed study of recent changes in the bed load of the lower Mississippi. They conclude that upstream from New Orleans the River has aggraded its bed, presumably with sand that has been eroded from bed deposits located farther upstream. Below New Orleans, it appears that sediment is being carried downstream directly to the Gulf without any intervening channel storage. It is not known, however, how this bed load discharge compares in magnitude to earlier pre-dam construction discharges.

Channelization of the Mississippi River for flood control and navigation has also affected sediment delivery to wetlands. Today, sediment from the River is discharged to the coast only through the main channel of the River and the Atchafalaya system. In prechannelization times, the flow of the River was distributed among several distributary channels, which would have delivered sediment to the coast over a broad area during high river stages. As an example, Bayou Lafourche was cut off from the Mississippi River as a result of levee construction shortly after the turn of the century. Cleveland et al. (1981) have used simulation models to demonstrate that if sediment from the Mississippi River were reintroduced into the Barataria Basin, an area experiencing high rates of land loss and fed by Bayou Lafourche, the basin would experience net wetlands gain during the next century.

Channelization of the main channel of the Mississippi River also prevents the overbank discharge of sediment-laden water onto adjacent marshes. The occurrence of crevasse splays along the banks of the river during high river stages has also been prevented. Turner and Cahoon (1988) estimate that about 6% of the current suspended sediment load of the river is being prevented from reaching coastal wetlands as a result of channelization projects that prevent the occurrence of these processes.

Sediment deprivation will continue as a major impacting factor during the period of analysis. Although the COE and university researchers are currently analyzing the feasibility of reintroducing alluvial sediments to coastal areas that are experiencing land loss, the great expense of these projects and the legal problems associated with the reduction in flood protection that will result from altering the River's levees and from discharging riverine waters across private property will prevent a sediment reintroduction plan from being implemented in the near future. Furthermore, even if sediment from the Mississippi River is reintroduced into coastal wetlands, the river is currently discharging less than half of its original sediment load.

The negative impacts of sediment deprivation on the coastal Louisiana wetlands is compounded by the rapid submergence rates that characterize the area. The eustatic rate of sea level rise during the past century has been about 2.3-2.8 mm/yr. The compaction and dewatering of coastal sediments in Louisiana has also resulted in a coastal subsidence rate in the range of 3-10 mm/yr, or 1-3 times greater than the eustatic rate (Turner and Cahoon, 1988). Rapid submergence will continue unabated as a major impacting factor. The eustatic rate of rise of sea level may possibly even increase in the future if the prediction of a global warming trend associated with increased carbon dioxide levels in the atmosphere proves correct. Geologic subsidence is a natural process that cannot be controlled by human intervention. Fluid withdrawals of formation water and hydrocarbons from oil fields have been sometimes suggested as a cause of the rapid subsidence that is occurring in some areas of coastal Louisiana. If this were the case, reinjection of fluids into deep formations could slow subsidence. Turner and Cahoon (1988), however, indicate that fluid withdrawals from oil/gas reservoirs appear to have only a localized influence on subsidence. Although subsidence can amount to as much as 80 cm directly above the reservoirs, the total area of oil/gas fields having a subsidence potential greater than 10 cm is only about 400 km^2.

The combined effects of subsidence and sediment deprivation can be sufficient to cause wetland deterioration in the absence of other impacting factors. Wells et al. (1983) have documented that the growth and decay of subdeltas and associated wetlands near the mouth of the modern main channel of the Mississippi River occur in cycles of about 100 years. These cycles are associated with natural processes, such as crevassing, channel extensions, channel abandonments, and subsidence, and appear to occur independently of anthropogenic factors such as canalization.

The impacts of canals on coastal wetlands include both direct and indirect impacts. The direct loss of wetlands associated with oil and gas development results from dredging activities, dredged material disposal, and canal widening. Indirect losses result from hydrologic changes that develop in wetlands after canalization has occurred. The indirect impacts of canalization that affect wetlands loss include drainage interruptions and saltwater intrusion. Scaife et al. (1983) indicate that drainage interruptions created by spoil banks are a primary factor affecting wetlands loss. Intersecting spoil banks partition areas of marsh and impede drainage. Poor drainage is deleterious to plant survival (Mendelssohn, 1981), and as vegetation dies in impounded areas, ponds appear. Ponds can grow and coalesce until, in extreme cases, entire areas of marshes can be converted to open water.

Canals can act as conduits for the inland movement of saline water. Saltwater intrusion can kill or weaken salt-intolerant plants, thereby contributing to wetlands deterioration. Saltwater intrusion is especially damaging to freshwater wetlands, although Turner and Cahoon (1988) indicate that some fresh marsh species can tolerate up to 11 ppt salinity for one month. Marsh vegetation characteristic of brackish and saline environments are more tolerant of saltwater intrusion. Turner and Cahoon (1988) have shown, using both field measurements and computer simulations, that saltwater intrusions are greater in artificially deepened canals than in shallow, natural bayous. The movement of saltwater from the canal into the marsh apparently occurs as overbank flow or through breaks in spoil banks. Turner and Cahoon (1988) were unable to show a correlation between canal water salinity and marsh-pore water salinity over a 2-month period, indicating that subsurface seepage of water from the canal into the marsh is not an important process.

According to the cumulative scenario (Table IV-1), OCS activities will result in two additional pipeline landfalls that will traverse 50 miles of coastal habitat and the construction of two new service bases and one new marine terminal. The construction of new facilities will not have a large impact on coastal wetlands. The direct impacts of all existing OCS support facilities has been only 96 acres (Turner and Cahoon, 1988). All recent pipeline projects in coastal wetlands in Louisiana have backfilled the pipeline trench after the line was installed. This construction practice results in direct impacts of 4.2 acres/mile in the Deltaic Plain and 2.8 acres/mile in the Chenier Plain. The range in possible direct impacts from new OCS pipeline projects is between 140 acres (if all pipelines traverse the Chenier Plain) and 210 acres (if all pipelines traverse the Deltaic Plain).

Although the total new direct and indirect impacts from future OCS activities will not be large, the ongoing indirect impacts from previous OCS-related canalization will continue to be significant. Of the 2,759 miles of OCS pipelines that have been installed in coastal Louisiana, Turner and Cahoon (1988) have determined that 77% of the total length of pipeline canals have been backfilled. Backfilling, by partially to completely filling in the canal and by levelling spoil banks, greatly reduces indirect impacts. The authors have also estimated that OCS-related traffic accounts for only a small percentage of commercial usage of major navigation routes through coastal Louisiana. Of 4,886 miles of navigation routes in the coast, they allocate only 205 miles (or 4%) to OCS traffic. Turner and Cahoon (1988) estimate that the indirect impacts of these OCS activities account for 4%-13% of the total amount of wetlands loss that occurred in coastal Louisiana between 1955 and 1978. These impacts have not been mitigated; therefore, the ongoing effects of marsh impoundment and saltwater intrusion will continue. The rate at which indirect impacts develop and then diminish over time is currently unknown. It is, therefore, impossible to quantify the level of continuing impact from canalization that occurred many years ago.

The majority of canalization that has occurred in coastal Louisiana has occurred as a result of onshore oil and gas activities. An indication of the extent of onshore oil and gas activity that has occurred in coastal Louisiana is provided by well completion data. Approximately 41,190 wells have been completed in coastal Louisiana (USDI, GS, 1984). Access canals and pipelines to service onshore development are pervasive throughout the coastal area. A total of 9,498 miles of pipeline canals to carry onshore production have been installed in coastal Louisiana. This figure compares to 2,759 miles of OCS pipelines. Although there is no available tally for the total number of rig access canals dredged in Louisiana, approximately 1,900 such canals were installed between 1978 and 1982 alone. This represents an annual average of 475 canals. The typical length of an access canal, as indicated on permits, is 1,200 ft. A representative annual length of new access canals might, therefore, be 570,000 ft or 108 miles. The ongoing indirect impacts from this pervasive network of pipeline and navigation canals will produce large impacts on coastal wetlands in the future.

Miscellaneous factors that impact coastal wetlands include marsh burning, marsh buggies, onshore oil and gas activities, well site construction, and brine disposal. Bahr and Wascom (1984) report major marsh burns that have resulted in permanent wetlands loss. Sikora et al. (1983) reported that in one 16 km^2 wetland area in coastal Louisiana, 18.5% of the area was covered with marsh buggy tracks. Well site construction activities include board roads and ring levees. Ring levees are approximately 4-acre impoundments constructed around a well site. With 41,000 onshore coastal wells drilled in Louisiana as of 1984, the total acreage of wetlands that have been impounded is substantial. Brine disposal associated with oil and gas exploration and production may have a significant local impact on wetlands near discharge sites.

Development of wetlands for agricultural, residential, and commercial uses is a major factor affecting wetlands loss in Louisiana. During the period 1952-1974 in the Chenier Plain area of southwestern Louisiana, an estimated 3,045 acres of wetlands were converted to urban use (Gosselink et al., 1979). During the period 1956-1978, an estimated 132,034 acres of urban/industrial development occurred in the Mississippi Deltaic Plain region of southern Louisiana (Bahr and Wascom, 1984).

The effects of spilled oil on coastal wetlands has been discussed above in the Base Case Analysis above. Under the cumulative analysis, the probability of contact between spilled oil and wetlands will increase compared to the Base Case. As indicated in Table IV-7, the chance of contact from the occurrence of one or more large spills resulting from the proposed action, prior and future OCS leasing, and the tankering of imported oil is greatest in the Deltaic Plain region (46% for the East Deltaic Plain and 96% for the West) compared to 41% for the Chenier Plain region. A few spills between 50 and 1,000 bbls (> 50 and < 1,000 bbls) are assumed to contact the coastline during the 34-year lease life, and a few spills in the size class > 1 and ≤ 50 bbls are assumed to contact the coast each year.

Sources of spilled oil other than those included in Table IV-7 include onshore pipeline leaks, spillage from tankers in estuaries, and spillage associated with onshore oil development. Statistics on shuttle tanker spills in estuaries indicate a 78%-89% chance of one or more large spills occurring (Section IV.B.1.d.). Although no statistics are available for the frequency of occurrence of pipeline leaks in wetlands, there are 12,257 miles of pipelines in the wetlands, a certain percentage of which are oil lines. Some of these lines were installed over 30 years ago and may have become structurally weakened over time. Leakage from sludge pits and spills at drilling and production sites can also introduce oil into wetland areas in association with onshore oil activities.

Based on the high probability that spilled oil will contact wetlands along the Central Gulf coast, it is reasonable to assume that several small spills and one large spill will occur and contact wetlands at several sites. Oil spills are not considered to be one of the major contributing factors to the wetlands loss problem in coastal Louisiana.

Wetland deterioration, however, will likely be exacerbated by spilled oil because most wetland areas are already being stressed by rapid submergence, sediment deprivation, and canalization impacts.

Conclusion

The level of cumulative impact on coastal wetlands in the Central Gulf is estimated to be very high due primarily to the high rate of wetland loss occurring in coastal Louisiana.

High Case Analysis

No new support infrastructure or navigation canals are anticipated to be constructed in the Central Gulf coastal area as a result of the proposed action (Table IV-1). Impacts from these activities would, therefore, be precluded. Some maintenance dredging of existing canals can be anticipated. As noted in Table IV-7 for the High Case, the OSRA model indicates a reasonably low percent chance (1%-11%) of occurrence and contact between an oil spill greater than 1,000 bbls and wetland areas in the CPA. It is therefore assumed that a large spill incident involving wetlands will not occur. It is likely that a spill > 50 and < 1,000 bbls will contact the coastline during the 34-year lease life and that a few spill incidents of the size class > 1 and ≤ 50 bbls will contact the coastline.

The impacts of oil spills on wetlands vegetation was discussed above in the Base Case Analysis. Only heavy concentrations of oil in marsh sediments have a deleterious impact on marsh vegetation. These impacts seem to be relatively short-lived, lasting perhaps one to two years. The impacts of a spill between 50 and 1,000 bbls and a few less than 1,000 bbls will have only short-term effects on marsh vegetation in localized areas of the coast.

Conclusion

A low level of impact on wetlands is expected in the CPA for the High Case.

(2) Impacts on Sensitive Offshore Habitats and Communities

(a) Live Bottoms (Pinnacle Trend)

The live bottoms of concern in the Central Gulf and adjacent areas of the Eastern Gulf are associated with the pinnacle trend area, which is located between 240 and 330 ft water depth in the Main Pass and Viosca Knoll lease areas. The pinnacles are scattered in this area and include recently documented live-bottom areas that are sensitive to oil and gas activities. Leases in past sales have contained a live bottom stipulation for protection of such areas, and a stipulation is presented in Section II.A.1.c.(2) as a potential mitigating measure for leases resulting from the proposed action. The impact analysis presented below is for the proposed action and does not include the biological lease stipulation.

To better understand the importance of this pinnacle trend area in biological and ecological terms and to fill significant data gaps in the area, an MMS-funded study of this area has been instituted: The Mississippi-Alabama Shelf Ecosystem Study. Field work on this study began in mid-1987. Findings will be incorporated into future oil and gas lease sale EIS's and may result in modification of the proposed stipulation.

The definitions used to describe the expected level of impact to the pinnacle trend live bottom areas resulting from the proposed action are listed in Table S-4.

Base Case Analysis

The potential causes of adverse impacts to the pinnacle trend resulting from oil and gas exploration and development are oil spills, blowouts, anchoring, structure emplacement, drilling discharge, and structure removal.

Oil from a surface spill can be driven into the water column. Measurable amounts have been documented at depths approximating 10 m driven into the water column. At this depth, the oil is only found at concentrations several orders of magnitude lower than the amount shown to have an effect on marine organisms (Lange, 1985; McAuliffe et al., 1975 and 1981). Surface oil spills would likely have no impact on the biota of the pinnacle trend since the crests of these features are much deeper than 10 m. There is a 21% chance of an oil spill greater than or equal to 1,000 bbls occurring in the Central Gulf as a result of the proposed action (Table IV-5). These oil spills may occur from either surface or seafloor sources. Surface spills could occur from shuttle tankers or oil platforms. Most of the small spills would occur from surface sources. The small and large subsurface spills are likely to result from pipeline spills.

If the spills were from seafloor sources, the impacts on the pinnacles could be different. A seafloor spill could occur from a pipeline rupture, a leak, or an oil well blowout. The biota of the pinnacles of the Central Gulf could be significantly impacted by a seafloor oil spill. The effluent could impinge directly upon the edge of the pinnacles. Impacts, including death, uptake of hydrocarbons, or reduced visibility, could then be serious to the local biota. However, these biota would recover once the pinnacles were clear of the oil.

While the probability of a large spill occurring is 21% for the Central Gulf, the probability of the spill being from a seafloor source is lower (i.e., 6%; Table IV-5). Even if a seafloor spill were to occur, the spill would have to come into contact with a pinnacle feature. The likelihood of this happening is very low, and even if it did, the oil would very soon be swept off the pinnacles by the current. These factors would serve to limit the extent of damage from any given spill, and for the purpose of this analysis, it is assumed that no oil from an oil spill comes in contact with the pinnacles.

Subsurface blowouts can pose a threat to the biota of the pinnacles if one were to occur near one of these pinnacles. Subsurface gas well blowouts generally pose far less environmental risk than do oil spills, resulting only in very high concentrations of suspended sediments and increased levels of gas in the water column very near the source of the blowout. To the extent that oil or condensate is present in the reservoir, some liquid hydrocarbons may also be injected into the water column. The suspended sediments may be carried some distance by currents, but the bulk of the sediments are redeposited within a few thousand meters of the blowout site. Hydrocarbons will be diluted to background levels within a few thousand meters distance from the blowout site and will degrade with time without major biological effect. A blowout could result in the smothering of the biota of a pinnacle due to sedimentation. However, these biota are adapted to life in turbid conditions and heavy sedimentation, and should mortality occur, recovery would be rapid. See also Section IV.C.3.

Considerable mechanical damage will be inflicted upon the bottom by conducting routine oil and gas operations without benefit of the proposed biological stipulation in Section II.A.1.c.(2). The drilling operation itself disturbs some small areas. Of the 59 blocks in the pinnacle trend area, 28 are available for lease. It is unlikely that a rig or platform would be emplaced directly on the pinnacles because of the unevenness of the seafloor. Such damage could be devastating to small areas of the habitat provided by the pinnacles so affected, which would, in turn, affect the usefulness of the pinnacles as habitat or shelter for commercial and recreational fishes.

Anchors from support boats and ships, floating drilling units, and pipeline laying vessels do a great deal of damage to the seafloor. The area actually affected will depend on depth of water, length of chain, size of anchor and chain, wind, and current. Anchor damage is the most serious threat to live bottom areas. Anchor damage would include crushing and breaking of pinnacles and associated communities. Anchoring often destroys a wide swath of habitat when the anchor is dragged or the vessel swings at anchor causing the anchor chain to drag the seafloor.

Pipeline emplacement also causes considerable disruption to the bottom (Section IV.A.3.). It is estimated that six acres of the bottom is physically disturbed per mile of pipeline laid; some 2,300-6,000 yds^3 of sediment are resuspended per mile of pipeline, depending on the size of the pipeline and depth of trenching (burial). Add to this damage caused by the eight anchors of the pipelaying barge and it is clear that considerable damage will be done if such activities are conducted in the pinnacle trend area.

Mechanical damage of an area of the pinnacle trend is likely to be permanent. The structural relief offered by the pinnacles would be severely reduced. This damage will be quite local in extent and is not likely to cause widespread impacts.

Routine oil and gas operations discharge drilling muds and cuttings. Drilling discharges will cause turbidity and smothering of the benthos in proximity to the drill site. In the Gulf of Mexico OCS, about 90% of the discharge settles rapidly, usually within 1,000 m. Impacts to the biota may also result from the toxic components of the drilling muds. Most water-based fluids are nontoxic and their effects limited to the immediate vicinity of the discharge (NAS, 1983).

Deposition of drilling muds and cuttings on the pinnacle trend area would not significantly impact the biota of the pinnacles or the habitat itself. The biota are adapted to life in turbid conditions and to high sedimentation. The depth of water would dilute the effluent to a significant degree. The pinnacles themselves are coated with a veneer of sediment. Any additional deposition and turbidity caused by a nearby well is not expected to significantly affect the pinnacle environment, since such are discharged into very large volumes of water (the open Gulf of Mexico) and rapidly disperse, can be measured above background at only very short distances from the discharge point, and have little biological effect except very close to the discharge point.

Removal of platforms may cause substantial impacts to the habitats which they are near. As previously discussed, the platforms are unlikely to be constructed directly over the pinnacles. However, the platforms may be located adjacent to the pinnacles. Structure removals immediately adjacent to a pinnacle have the potential to impact the pinnacle habitat. Both explosive and nonexplosive removal operations will disturb the seafloor and resuspend sediments in the water column, resulting in turbidity. Structure removal using explosives (the most common removal method) can suspend sediments throughout the water column to the surface. Deposition of these sediments would occur much in the same manner as discussed for muds and cuttings discharge. Explosive structure removals create shock waves which could also harm resident biota. Impacts to the pinnacle area from structure removal are expected to be moderate.

Activities resulting from the proposed action, particularly anchor damage to localized pinnacle areas, are expected to have a high level of impact on small portions of the pinnacle trend environment, since these activities could totally destroy one or several individual pinnacles. However, the impact to the pinnacle trend area as a whole is expected to be low because no community-wide impacts are expected.

Conclusion

The impact to pinnacle trend is expected to be moderate.

Cumulative Analysis

This cumulative analysis considers the effects of impact producing factors related to the proposed action plus those related to the Western Gulf proposed action, prior OCS sales, future OCS sales, tanker and other shipping operations, commercial fishing, and recreational activity that may occur and adversely affect live bottoms associated with the pinnacle trend area. Specific types of impact producing factors considered in the analysis include drilling rig, platform, and pipeline emplacement; well drilling (discharges); hydrocarbon production (produced waters); blowouts; oil spillage; anchoring; and operational discharges by tank ships.

Cumulative OCS activity near live bottoms is estimated to be much higher than under the Base Case. This level of activity, if performed without benefit of the proposed biological stipulation in Section II.A.1.c.(2), is estimated to result in a number of impact causing events which, in aggregate, would be sufficient to produce a higher level of impact on the pinnacle trend live bottom environment at several locations. However, the impact is moderate.

Mechanical damage due to anchoring is expected to be the most serious threat to the pinnacle trend environment. The area of the pinnacle trend is located near a shipping fairway. Ships using this fairway into Mobile, Alabama, can be expected to anchor in this area on occasion. Fishermen may anchor here to fish. It is estimated that several instances of severe and permanent mechanical damage to the pinnacles are likely to occur over the period 1989-2023.

The probability of an oil spill will increase under this scenario, but most of that increase would be from surface spills from other than OCS production activities, such as import tankering; surface spills are not expected to impact pinnacle trend biota. The risk to these biota from a seafloor spill would be about the same as for the Base Case.

Impacts to the pinnacle trend could occur as a result of the release of operational discharges. Due to the dilution factor and the depths of the pinnacles, this activity is not expected to have a high level of impact on the pinnacles.

The level of cumulative impact to the pinnacle trend environment of the Central Gulf is estimated to be high for small portions of the area due to bottom-disturbing activities. However, the impact to the pinnacle trend area as a whole is expected to be low because no community-wide impacts are expected.

Conclusion

The impact to pinnacle trend is expected to be moderate.

High Case Analysis

The pinnacles and the biota of the live bottom areas would be subject to physical destruction from rig emplacement, platform and pipeline installation, and anchoring. Because the offshore infrastructure estimates (wells and platforms) are slightly greater in this scenario, the possibility of an operation occurring on or near a sensitive offshore habitat would be slightly greater than for the Base Case. Therefore, the probability of an impact, including a seafloor oil spill, occurring would be slightly greater than for the Base Case.

The expected level of impact from the High Case is expected to be very high to small local areas directly impacted by bottom-disturbing activities. However, the impact to the pinnacle trend area as a whole is expected to be low because no community-wide impacts are expected.

Conclusion

The impact to pinnacle trend is expected to be moderate.

(b) Deepwater Benthic Communities

The deepwater benthic communities consist of newly discovered organisms that derive their energy, in the absence of light, from chemosynthetic processes rather than the photosynthetic processes of shallow water. The primary chemosynthetic organisms are apparently bacteria, both free-living (as "bacterial mats") and symbiotic in the tissues of other organisms, especially in the gills. The predominant large animals are tube worms, clams, and mussels. The major impact producing factors are those activities that would physically disturb the bottom, such as anchoring, drilling, and pipeline installation. Because of the great water depths, discharges are not expected to be a problem. Since these communities use petroleum hydrocarbons as a food source--and indeed have been seen to be living among oil and gas bubbles--oil spills are not considered to be a potential source of adverse impacts.

The definitions used to describe the expected levels of impact to the deepwater benthic communities resulting from the proposed action are listed in Table S-4.

Base Case Analysis

Impacts to deepwater (greater than 400 m) benthic communities (e.g., chemosynthetic communities) will occur as a result of continued OCS activities in the Central Gulf.

The greatest potential for adverse impacts to occur to such communities would come from those OCS related activities associated with pipelaying, anchoring, and structure emplacement. These activities, which lead to localized bottom disturbances and disruption of benthic communities in the immediate area, would be minimal in regions of suspected high-density chemosynthetic communities. Considerable mechanical damage would be inflicted upon the bottom by routine OCS drilling activities. The drilling operation itself disturbs a small bottom area. The presence of a conventional structure can cause scouring of the surficial sediments (Caillouet et al., 1981) and it has been estimated that between 1-4 acres of bottom may be disturbed from platform emplacement activities alone. Anchors from support boats and ships (or more likely in these water depths, from any buoys set out to moor these vessels), floating drilling units, and pipelaying vessels also cause severe disturbance to small areas of the seafloor. The area affected will depend on the water depth, length of the chain, size of the anchor, and current. Anchoring will destroy those sessile organisms that are actually hit by the anchor or anchor chain during anchoring and weighing anchor operations. While such an area of disturbance may be small in absolute terms, it may be large in relation to the area inhabited by chemosynthetic organisms. Normal pipelaying activities in deepwater areas consist of laying the pipe along the seafloor. This in itself could highly impact communities such as Bush Hill, which are areas of high biomass; little is known at present of the size, number, or locations of these important communities, although it is known that they are associated with hydrocarbon seeps and gas- and/or oil-charged sediments. It is these areas that are most at risk from oil and gas operations. It is likely that pipelines will be used to transport product ashore from those deepwater areas in close proximity to the current pipeline network in both the Central and the Western Gulf. In the extreme deepwater provinces, shuttle tankering would substitute for pipeline as a means of transporting product; therefore, impacts to these deepwater communities, from this type activity, would be precluded in the more isolated areas. As discussed in Section III, the majority of these benthic communities are of low diversity and widespread throughout the deepwater areas of the Gulf and would tend to repopulate disturbed areas. The disturbance of the Bush Hill-type community, as identified in Section III, could lead to the destruction of the community, such that recovery would not occur. Due to the recent discovery of this type community, the vulnerability to impact, recoverability, and general extent of the community are unknown.

It is highly unlikely that discharges resulting from the proposed activities would impact the benthos in the water depths being discussed, due to the rapid dilution and dispersion of effluent components. In shallower depths, cuttings tend to form a low mound or be worked into the surrounding sediments, depending upon the nature of the local sediments, depth of disposal, and physical forces acting upon the pile. Since they are discharged into very large volumes of water (the open Gulf of Mexico) they rapidly disperse, can be measured above background at only very short distances from the discharge point, and have little biolgoical effect except very close to the discharge point.

NTL 88-11 became effective on February 1, 1989. The NTL formalizes the review process and makes mandatory the search and avoidance of "plush" chemosynthetic communities or the areas that, through interpretation of geophysical records, have a high potential for supporting these community types. The regions that have high potential for conditions that may support chemosynthetic communities, if not avoided initially, must be photodocumented and then re-evaluated. Avoidance of any regions with high-density chemosynthetic communities will still be required, although some regions may be "cleared" through this process.

However, a second issue, which has yet to be adequately addressed, is the potential impact to the organisms by the withdrawal of the hydrocarbons (the food source) from beneath the community. The seeps and vents around which these animals live are pressurized from the deep reservoirs that force the gas or oil to the seafloor. When all of the economically recoverable hydrocarbons from these reserviors are withdrawn by production operations, it is possible that oil and gas venting or seepage would also stop. Current information does not allow a determination to be made as to whether this slackening of the pressure, which drives the seeps, would be reduced quickly (as they have been on land) or whether there may be enough oil already in the "conduit" to the surface to continue the seepage for long periods of time. Available information indicates that the driving force of the seeps may be water or oil and gas; it is not well known. Nonetheless, the issue of long-term impacts are poorly understood at this time. Long-term impacts to these communities from the withdrawal of oil and gas will most likely include a reduction of the amount of hydrocarbons available for metabolic processes. It should also be remembered that some of these communities derive energy from sulfide-rich environments and may not be impacted by reservoir depletion. However, the main question of the long-term impacts remains unanswered.

The probability of impact to a sensitive deepwater benthic community is expected to be low due to the small number of surface disturbing activities in deep water, the localized extent of the disturbance, and the apparently widely scattered and isolated nature of the sensitive communities. However, a Bush Hill-type community could be totally decimated if a drilling activity or anchoring took place right on top of it.

A Notice to Lessees (NTL) to detect and protect deepwater, high-density chemosynthetic communities has formalized the review and mitigating measures procedures being performed by MMS in water depths greater than 400 m and is discussed in Section II.A.1.c.(2). It is believed that this process serves to locate nearly all, if not all, the Bush Hill-type communities likely to be impacted by a specific operation. Adoption of this NTL results in the potential impact to the high-density chemosynthetic communities being reduced from very high to moderate.

Conclusion

The level of impact on the deepwater benthic communities of the Bush Hill-type in the Central Gulf resulting from the proposed action is expected to be moderate because of implementation of the NTL. The impact to the widespread low diversity areas is expected to be low.

Cumulative Analysis

Cumulative factors considered to impact the deepwater benthic communities of the Central Gulf include both oil- and gas-related and non-oil- and gas-related activities. The latter type of impacts include activities such as fishing, trawling, and anchoring. However, fishing and trawling in the deeper waters of the Central and Western Gulf are minimal and impacts are very low. Oil- and gas-related activities include pipeline and platform emplacement activities and anchoring, which is expected to be much higher than under the Base Case. The analysis considers the effects of these factors related to the proposed action, prior and future OCS sales.

As in the case of the proposed action, the greatest potential for adverse impacts to occur to the deepwater benthos stem from pipeline and platform emplacement and associated anchoring activities. The impacts to benthos from these activities are discussed above. As exploration and development continues on the Federal OCS, activities in the Central and Western Gulf regions have moved into the deeper water areas of the Gulf of Mexico. With this trend comes the certainty that increased development will occur in these areas, accompanied by stress to the deepwater benthos from bottom disturbances and disruption of the seafloor from associated activities. The extent of this disturbance shall be determined by the intensity of development in these deepwater regions as well as the types of structures and mooring systems utilized.

Conclusion

The cumulative level of impact on the deepwater benthic communities of the Bush Hill-type in the Central Gulf is expected to be moderate. The impact to the widespread low diversity areas is expected to be low.

High Case Analysis

The deepwater benthic communities (e.g., chemosynthetic communities) would be subject to very limited physical destruction from rig emplacement, platform and pipeline installation, and anchoring. As noted under the Base Case, it is highly unlikely that discharges from the proposed activities would adversely impact the benthos in the water depths (greater than 400 m) being discussed, due to the rapid dilution and dispersion of effluent components. Because the offshore infrastructure estimates (wells and platforms) are greater in this scenario, the possibility of an operation occurring on or near a sensitive deepwater benthic community, of the Bush Hill type, would be greater than for the Base Case. Therefore, the probability of an impact occurring would be greater than for the Base Case.

Conclusion

The level of impact on the deepwater benthic communities in the Central Gulf from the High Case to Bush Hill-type communities is expected to be moderate. The impact to the widespread low diversity areas is expected to be low.

(c) Topographic Features

The potential impact producing factors to the topographic features of the Central Gulf are oil spills, blowouts, anchoring, structure emplacement, effluent discharge, and structure removal. See Table S-4 for definitions of the impact levels.

The description of the impacts to the topographic features of the Central Gulf is hereby incorporated by reference from Final EIS 113/115/116 (USDI, MMS, 1987b, pages IV-101 through IV-107) and from Final EIS 118/122 (USDI, MMS, 1988c, pages IV-84 and IV-85). Presented below is a summary of that material. Except for the OSRA numbers and the quantities of material expected to be discharged into the Gulf as a result of this proposal, the referenced analyses are valid for this proposed action.

Oil spills may occur at the surface due to tanker spillage and platform spills or at the seafloor due to pipeline rupture or well blowout. Both surface and subsurface spills could result in a steady discharge of oil over a long period of time.

Blowouts can occur from either oil or gas wells. Oil well blowouts may result in oil spills. Both gas and oil subsurface well blowouts result in large amounts of bottom sediment being thrown into the water column.

Anchoring of pipeline lay barges, drilling rigs, or work boats and structure emplacement (pipeline, drilling rig, or platform emplacement) result in physical disturbance of the benthic environment. These bottom-disturbing activities are the most likely to cause permanent or long-lasting impacts to sensitive offshore habitats.

Drilling muds and cuttings discharges result in localized water turbidity, deposition on the surrounding seafloor, and potential effects of the low concentrations of toxic constituents. Formation waters are routinely discharged during production operations.

Structure removal results in water turbidity, sediment deposition, and potential explosive shock wave impacts.

The impact producing factors are discussed more thoroughly in Section IV.A.3.

Base Case Analysis

The topographic features of the Central Gulf providing sensitive offshore habitats are listed in Section III.B.2.

Sensitive offshore habitats are most seriously affected by disturbance from the anchoring of service vessels and drill rigs and from the emplacement of structures such as rigs, platforms, and pipelines. Disturbance from such activities is likely to cause permanant or long-lasting impacts. Since topographic high communities tend to be located above salt domes, which are ideal oil and gas producing structures, disturbance could be expected to occur at each of these communities.

The resuspension of sediments disturbed during a subsurface blowout and the settling of drilling muds and cuttings result in localized water turbidity and deposition of the materials on the surrounding seafloor, with additional potential harmful effects from concentrations of toxic constituents, which could cause the smothering of local benthic communities or induce stress in part or all of a local community. Again, the high probability that activity would take place on or near each of the topographic features means that each would likely be subjected to some stress from particulate or toxic materials.

There is an estimated 21% chance of an oil spill greater than or equal to 1,000 bbls occurring in the Central Gulf as a result of the proposed action (Base Case) (Table IV-5), and it is estimated that one small spill of > 1 and ≤ 50 bbls will occur each year and that one spill 50 > 50 and < 1,000 bbls will occur during the 34-year lease life (Section IV.B.2.). No sensitive offshore habitats are likely to be contacted because the oil is unlikely to reach the depths of these habitats.

Removal of platforms constructed on or very near sensitive habitats (in the absence of the proposed stipulation of Section II.A.1.c.(1)), if carried out using current methods of explosive removal, would adversely affect benthic habitats very near to the removal site. However, the relatively small size of the charge and the fact that the charge is detonated 16 feet below the mudline would serve to restrict the impacts to very close to the structure being removed. See Section IV.A.3.j. of this EIS and especially Section IV.A.3.j. of Final EIS 118/122 (USDI, MMS, 1988c, pages IV-35 to IV-37) for more information regarding structure removals.

Conclusion

The proposed action is expected to have a very high impact on the sensitive offshore habitats of the topographic features.

Cumulative Analysis

Oil and gas leasing has been increasing around the topographic features of the Central Gulf, and this trend is expected to continue in the future. Of the 167 blocks in the CPA that are near the topographic features, 102 are under active lease (Appendix A). The impact from cumulative oil and gas routine operations includes the impacts from the operations conducted as a result of the proposed action, future OCS sales past sales (which include the biological stipulation of Section II.A.1.c.(1)), and the tankering of imported oil.

Anchor damage and damage from structure emplacement are considered to be the most serious threats to coral and coral-community areas. The biological stipulation on the existing leases prohibits the anchoring of industry-related vessels and the emplacement of structures by the industry in the No Activity Zones; the stipulation does not affect other activities such as anchoring, fishing, or recreational SCUBA diving nor would it prohibit industry-related anchoring on leases as a result of the proposed action. No data are available on the extent to which such anchoring may take place; however, all three activities are known to occur in proximity to the topographic features.

Nearly all the banks are near the established shipping fairways. The banks are apparently well-known fishing areas. Several of the shallower cresting banks are SCUBA trip destinations. Anchoring at a topographic feature by a vessel involved in any of these activities would cause significant damage to the biota, although the degree of damage would depend on the size of the anchor and chain. There is potential for serious anchor damage to the biota of topographic features. Treasure hunters have destroyed large areas of Bright Bank by using explosives to blast through the coral reef. The impact has been high to Bright Bank as a result of this blasting activity.

Increased leasing near topographic features increases the probability that a blowout or seafloor oil spill may occur in proximity to a feature. There is an estimated 99+% chance of a large oil spill (1,000 bbls or greater) occurring in the Central Gulf as a result of the cumulative analysis (Table IV-5). It is also estimated that a moderate number of small spills of > 1 and ≤ 50 bbls will occur each year and that a few spills > 50 and < 1,000 bbls will occur during the 34-year lease life (Section IV.B.2.). Such an occurrence could be catastrophic in the immediate vicinity of the blowout; however, the probability that the oil spill or suspended sediments would reach a bank is low. Therefore, no spill-related impacts are anticipated.

Impacts to the topographic features could occur as a result of operational discharges from import and shuttle tankers. Due to the dilution factor and the depths of the banks, this activity is not expected to have a high level of impact on the topographic features.

Impacts from natural occurrences such as hurricanes are not expected to result in damage to the banks.

Conclusion

The level of cumulative impact on the sensitive habitats of the topographic features of the Central Gulf is estimated to be very high.

High Case Analysis

Higher oil and gas activity may be expected near the topographic features of the Central Gulf as a result of this scenario. The biota of the topographic features would be subject to physical destruction from rig emplacement, platform and pipeline installation, and anchoring. The biota would also exhibit effects ranging from short-term stress responses to mortality resulting from the discharges associated with drilling. Because the offshore infrastructure estimates (wells and platforms) are greater in this scenario, the possibility of an operation occurring on or near a sensitive offshore habitat would be greater than for the Base Case. There is an estimated 37% chance of an oil spill greater than or equal to 1,000 bbls occurring in the Central Gulf as a result of the High Case (Table IV-5). It is also estimated that a few spills of > 1 and ≤ 50 bbls will occur each year and that a few spills of the size class > 50 and < 1,000 bbls will occur during the 34-year lease life (Section IV.B.2.). Therefore, the probability of an impact occurring would be greater than for the Base Case.

Conclusion

The level of impact to the sensitive habitats of the topographic features of the Central Gulf is estimated to be very high.

(3) Impacts on Water Quality

The five impact levels to be used in the following analyses of potential impacts on both offshore and coastal or nearshore water quality are defined in Table S-4.

Under normal offshore operations, varying degrees of water quality degradation will occur as a result of oil and gas exploration and development activities in the Gulf of Mexico. Wastes from these activities are varied and may be transformed chemically, biologically, or radioactively when introduced into the marine environment. These wastes may be dissolved and form new substances or be mixed vertically and horizontally in the water column by small-scale motions or large-scale currents, and they may fall into the bottom sediments or be recycled by these same processes. This series of transformations or chemical reactions will govern a waste's transport through the water column and its toxicity to marine organisms. The method of delivery to the environment as well as the intrinsic chemical properties of each source will influence a waste's distribution throughout the Gulf.

(a) Coastal/Nearshore

Coastal/nearshore water quality may be altered by a number of activities resulting from OCS oil and gas development, including routine point and nonpoint discharges from onshore support facilities, discharges from shuttle tanker/barging and support vessel traffic while in the coastal area, canal dredging and pipeline emplacement actions, altered hydrology due to the presence of leveed canals and pipelines, produced waters from OCS platforms discharged in coastal waters, and oil and chemical spills. The following discussion addresses each of these potential impacts to coastal water quality.

Base Case Analysis

Effects of Routine Point and Nonpoint Source Discharges

Routine discharges from onshore support facilities may impact local onshore water quality. A general discussion of these point and nonpoint source discharges and the types of contaminants discharged from support facilities are described in Section IV.A.3.a. It is anticipated that the current onshore infrastructure base in the Central Gulf is currently sufficient to support proposed Sale 123 and that no new infrastructure will be built (Table IV-1). No discharges, therefore, such as nonpoint source runoff, would occur from construction operations or from modifications of existing hydrologic conditions. Up to 10% of the existing infrastructure will be used to support the sale activities, and routine discharges from these facilities would be entering the coastal waters. However, given the facts that point source discharges are limited by regulations of both Federal and State water pollution agencies and that the discharges would be of such small quantities, it is expected that such routine releases to coastal waterbodies due to any sale-related activities would contribute only slightly to water quality degradation.

Effects of Canals and Pipelines

Dredging of new canals to transport service vessels from shore-based facilities to OCS platforms, to provide general access to shore-based facilities, and for emplacement of pipelines results in sediment suspension, increased water column turbidity, and the possible release of contaminants present in the bottom sediments. A general discussion of the impacts resulting from dredging operations is presented in Section IV.A.3.f.

Although no new pipelines or canals are projected to be built due to this proposed sale, some portion of the 2,759 miles of the existing onshore pipeline network and 205 miles of existing major onshore navigation channels (Section IV.A.2.e.(1)) would be accessed to transport vessels, materials, and oil and gas ashore. The presence of a network of canals and pipelines in coastal areas, particularly in Louisiana, has altered the hydrology of the area. Modifications of wetland hydrology have isolated marsh areas due to canal levees or pipelines or have resulted in saltwater intrusion into more fresh areas (Sections IV.A.3.e. and f.). Saltwater intrusion or altered water movement in a marsh system are considered to degrade wetland water quality.

Examination of the effects of existing levee systems showed that water flow between the channel and the adjacent marsh was disrupted (Turner and Cahoon, 1988). The velocity of water flow within the undisturbed inland marsh soil was estimated to be an order of magnitude greater than through the spoil bank or natural levee soils. Large continuous levees clearly disrupt the movements of water into and out of a marsh and, therefore, affect the marsh salinity regime. The existing network of canals and their levee systems continue to have long-term impacts on the water quality of the wetlands.

Results of a recently completed MMS study (Turner and Cahoon, 1988) showed that there has not been any long-term trends in increased salinity in the marsh, which could be due to the existing network of canals and pipelines. However, saltwater intrusion does occur when deepening a channel. Therefore, any maintenance dredging, which would deepen old channels, would result in saltwater intrusion impacts and degraded water quality. It is assumed that the majority of the existing canals would have to be dredged during the 34 years projected as the life of the proposed sale. As noted by examination of COE permit applications, a large percentage of the most recent applications are for redredging of the existing network of canals in Louisiana. Based on the above, it is expected that changes in water quality due to changes in the saltwater hydrology of Louisiana would be impacted to a low degree due to use of the existing pipeline and canal network by activities associated with this proposed action.

Effects of Produced Waters

An examination of the amount and the effects of produced waters piped ashore from OCS activities has recently been completed by Boesch et al. (1988) in a study conducted for MMS. The study's estimated discharge amounts and a discussion of the effects observed at the three sites analyzed are presented in Section IV.A.3.a., along with a general discussion of produced waters.

The study analyzed produced water discharged into Louisiana coastal areas from OCS operations. Results of the study determined that significant impacts are taking place around the discharge sites. Elevated levels of salinity were found in a bottom plume extending out from the discharge site, and dispersion depended on the tidal current regime. The produced water plume contained elevated levels of dissolved and dispersed petroleum hydrocarbons, organic acids, and trace metals. Substantial hydrocarbon contamination of fine-grained sediments were observed extending out from several hundred meters to over one kilometer from the point of discharge. Elevated levels of salinity were not causing significant effects because the points of discharge were located near the coast. Concentrations of polynuclear aromatic hydrocarbons in sediments exceeded apparent background levels by over an order of magnitude. The results of the study found effects higher than previous studies of coastal impacts from produced water discharges because of the larger volumes of produced waters discharged from OCS separation facilities. Figures IV-5 and IV-6 show the discharge sites currently being used in Louisiana to discharge produced water from both OCS and State oil development activities. At present, 443,072 bbls per day of OCS-produced waters are being discharged into Louisiana coastal waters, approximately 50% of this being discharged into the Mississippi River Delta area (Boesch et al., 1988).

The amount of OCS-produced water projected to be discharged into Louisiana coastal waters during the 34-year lease life is 0.55 billion bbls, or 44,319 bbls/day. This amount is based on the assumption that 38% of the total amount of OCS-produced waters projected for this proposed action (Table IV-1) will be piped ashore (Boesch et al., 1988). This amount (44,319 bbls/day) approximates the average amount discharged from the study sites recently examined in the MMS study, and it can be assumed that effects observed would be similar. In conclusion, discharges of produced water into coastal areas from Sale 123 would have high water quality impacts in a few localized areas.

Effects of Accidental Spills

Oil spills can have significant long-term or minor, acute impacts on the water quality of the affected areas. Impacts could result from oil spills occurring from OCS activities and reaching land or occurring in coastal areas from shuttle tankering, service vessels, or OCS pipelines crossing coastal areas. Spills could also occur at refineries and tank farms, spilling both crude oil and a number of products, such as jet fuels, diesel fuel oil, and gasoline; or at marine terminals such as transshipment terminals, crude oil receiving terminals, or product terminals during offloading or onloading operations.

Once oil is spilled, a number of processes occur that alter the chemistry of the oil and modify its characteristics in water (Section IV.B.3.). The vast majority of the oil that would reach nearshore open waters would be in the form of a slick floating on the surface of the water. Offshore cleanup operations may remove a majority of the oil from the sea surface. However, given the complexity of the factors affecting clean up operations, at a minimum, it is assumed that 15% of the spill would have been cleaned up. Including this percentage as part of the percent reduction in the slick's volume, it is assumed that within 30 days 99% of the floating slick would have dissipated (Section IV.B.3.). About 1%-5% of the volume of the surface slick is predicted to dissolve in the water column. A larger percentage could be measured in the water column at any one time but would have a shorter residence time as the oil is absorbed onto particulate matter deposited on the seafloor or taken up by organisms. The relative amount of oil that resides in the water column is a function of a number of factors, including the point of release (surface versus subsurface), the hydrographic conditions affecting the surface slick, and the amount of sedimentary material in the water. Given the above, it is projected that a large oil spill reaching coastal waters would alter the water quality of nearshore waters for a short time and that the oil would weather and would unlikely be detectable in significant quantities within 30 days after the spill occurs. The OSRA model indicates a very low percent chance (5%) (Table IV-7) of a large oil spill occurring and contacting land in the CPA. The OSRA target "land" is used here to describe contact to nearshore open waters. It is assumed that no spills in the spill category > 50 and < 1,000 bbls will contact the coastline and that a low percentage of spills > 1 and ≤ 50 bbls will occur in proximity to coastal resources. Spills less than 50 bbls will be discussed below under chronic long-term pollution. Given the above factor, it is expected that oil spills greater than 50 bbls occurring offshore as a result of this proposed sale would not cause significant changes to the nearshore open water quality.

If the slick were to reach protected bays, wetland areas or areas behind barrier islands, the dissipative factors reducing its concentrations in water would be slower due to the low energy of such areas and the thickness of the oil on the isolated water bodies. Oil that might coat the sediments and vegetation might be released over a longer time frame. Studies of spills occurring in the Louisiana and Texas wetlands have shown that the spills resulted in the destruction of vegetation and resultant erosion, and in the release of oil from contaminated sediments into overlying waters (Secton IV.D.1.a.(1)(b)). When a dense oiling of the marsh surface occurred, significant effects were observed for over one year from the time of the spill. Based on these study conclusions, it is assumed that if a large spill would occur and result in heavy oiling of the surrounding marsh, very high impacts to water quality would

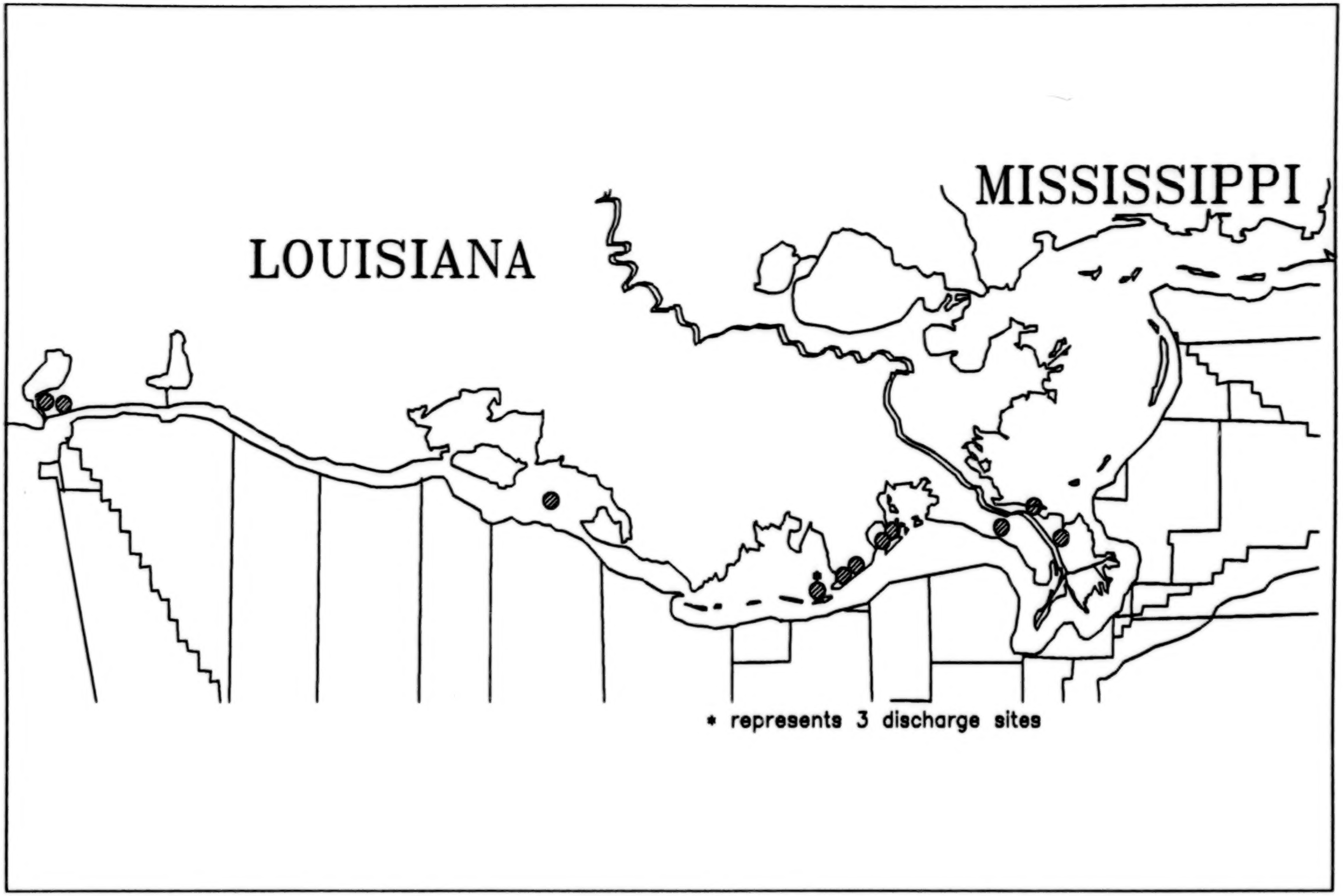

Figure IV-5: Locations of OCS-Generated Produced Water Discharges in Coastal Louisiana (Boesch et al., 1988).

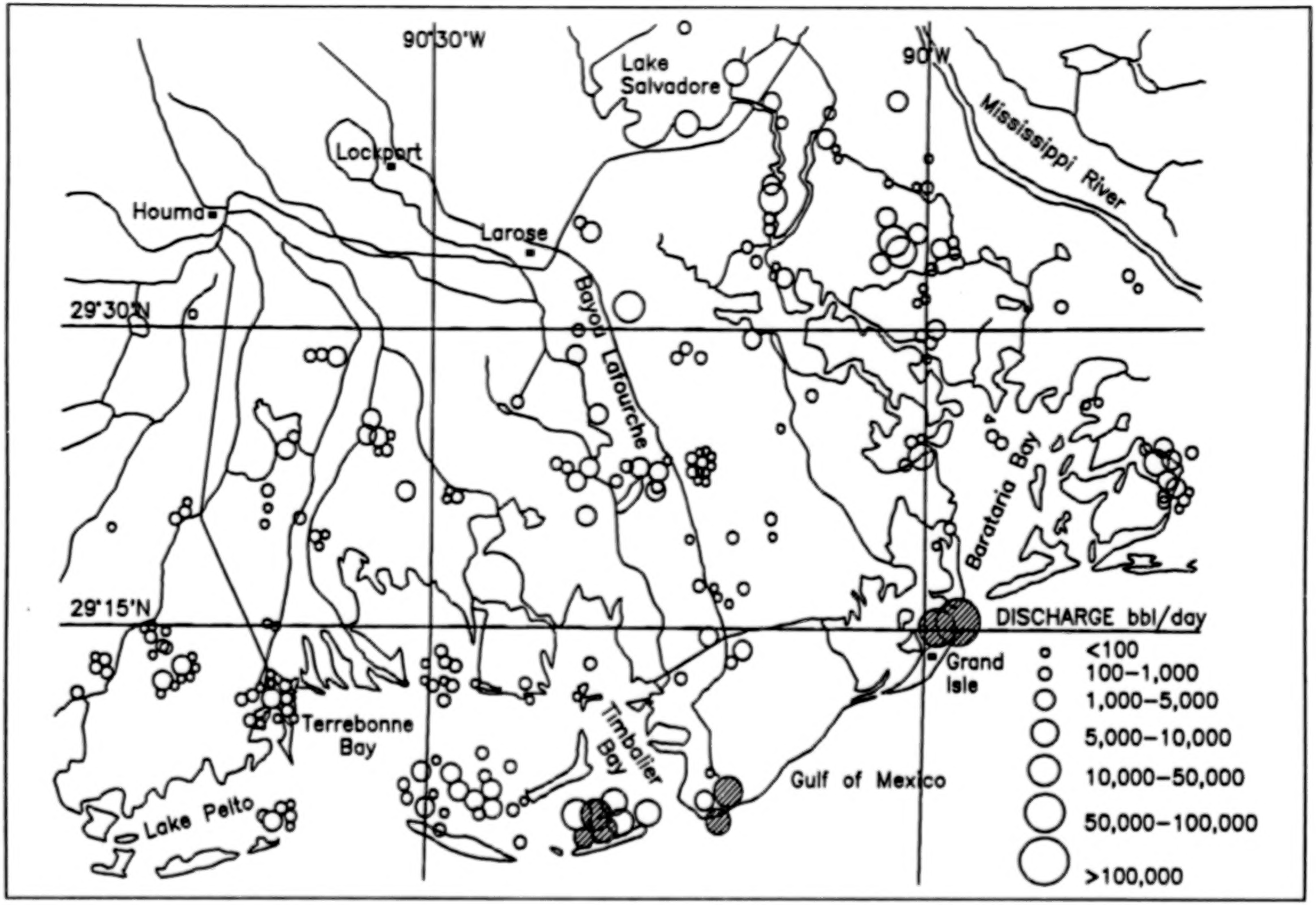

Figure IV-6: Locations of produced water discharges in Louisiana's Terrebonne and Barataria estuarine systems; hatched circles represent OCS-generated produced water (Boesch et al., 1988).

occur from sediments released into the water column due to erosion processes and due to the transport of oil overlying water within the spill site.

Small spills greater than 50 bbls could likely result in the same level of impact that is described above for large spills with the exception that the impact would occur in a slightly more localized area. The discussion found in Section IV.D.1.a.(1)(b) on studies examining the effects of oil spills on wetland habitats describes spill incidents within the size category > 50 and < 1,000 bbls. These studies show that it was the density of oiling as well as the size of the spill that determined the level of impact. Spills in the size class > 1 and ≤ 50 bbls would be unlikely to meet the criteria of heavy oiling and, therefore, would be unlikely to cause any short-term deleterious water quality degradation. Spills less than 50 bbls including spills of one barrel and less could contribute to long-term chronic contamination of the water column. Chronic pollution is addressed below.

The OSRA model indicates low percentages (less than 0.5%-6%) of a large oil spill occurring from offshore platforms, pipelines, or shuttle tankering operations and contacting bays and marsh areas (Table IV-7). The Louisiana western deltaic marsh has the highest percent chance of contact (6%). Large oil spills occurring from shuttle tankers while in the coastal area are presented in Section IV.B.2. The OSRA model indicates that there is only a 1% chance for the occurrence of a large oil spill. Statistics on oil spills occurring from OCS acitvities in coastal waters, such as from pipelines which traverse the coastal marsh, are not available. However, given the fact that there is only a 6% chance of a large oil spill occurring from the offshore pipeline network (Table IV-5), it is reasonable to assume that it is unlikely that a large spill would occur from the part of the pipeline network that traverses the coastal region. Based on the low percentage chance of contact with coastal waters from large oil spillage incidents occurring due to OCS activities, it is assumed that no large oil spills would occur and impact coastal inland water quality.

Spill statistics less than 1,000 bbls are discussed in Section IV.B.2. No spills in the size category > 50 and < 1,000 bbls are expected to contact the coastline. The assumption for spills of > 1 and ≤ 50 bbls or less is that a very low percentage of these spills would occur in the OCS area in proximity to the CPA coastline.

To address the issue of chronic petroleum contamination of the CPA coastline, studies that analyzed Gulf coastal sediments and biota to determine if petroleum hydrocarbons are being concentrated were examined. The following study conclusions are extracted from the Texas A&M University (1988) *Second Annual Report of the NOAA Mussel Watch Program*, which addressed the current condition of the Gulf's water quality. Baseline studies in 1978-1979 at the brine disposal sites off the Louisiana and Upper Texas Coast detected the presence of petroleum hydrocarbons in water, biota, and sediments. The report concludes that the presence of the petroleum hydrocarbons is due to the influence of the Mississippi/Atchafalaya riverine inputs, petroleum operations, and transportation activities. In 1977, the USEPA Mussel Watch Program showed that oysters in Gulf coast areas near known inputs of petroleum hydrocarbons exhibited elevated concentrations of polynuclear aromatic hydrocarbons (PAH's) above those found in remote areas. Another study near Biloxi found similar results. Results of the recently completed NOAA Mussel Watch Program's Second Annual Report data analysis showed that 289 Gulf Coast oysters samples, used as indicators of water quality, were showing contamination with petroleum hydrocarbons. However, the total PAH concentrations measured in Gulf of Mexico oyster and sediment samples are generally lower than PAH concentrations at East and West U.S. coast locations, probably due to the fact that the sites in the Gulf are further removed from point sources. In summary, these studies have showed that (1) chronic petroleum contamination is taking place partially from oil and gas operations along the Gulf of Mexico coastline, but (2) water quality degradation is not taking place to such an extent to show marked increases over U.S. coastal areas that do not have as much oil operations.

Effects of Support Vessel Traffic

Shuttle tankering will carry 48% of the oil produced ashore. It is estimated that 21 shuttle tanker trips from offshore facilities to shore-based terminals will occur during peak years of production. Other service vessels carrying personnel and supplies will make an estimated 3,671 trips to shore per peak year (Table IV-1). Water quality could be degraded by the support vessel traffic, primarily through introduction of petroleum hydrocarbons from accidental spillage, chronic discharge of oil and fuels, and the release of antifouling paints to surrounding waters. These discharges could occur in connection with the offloading of crude from shuttle tankering activities, fueling activities associated with supply boat support, and the discharge of bilge water. Supply boats also degrade water quality by discharging domestic and sanitary wastes and by throwing trash overboard. Tributyltin, a major component of many antifouling paints used on marine boats, vessels, and tankers, has been shown to have toxic effects on some marine biota. Tributyltin has recently been regulated to decrease the total amounts released into the environment from marine paints. Although it is expected to slow environmental loadings, some amounts will still be entering the marine environment. Monitoring programs will be established to determine how harmful these reduced quantities will be. Support vessel discharges affect the water quality along coastal navigation channels, at service bases located in the wetlands, and at highly populated, confined harbors and anchorages with a large amount of marine traffic. The impacts from such chronic discharges is expected to be moderate in a few locations along the coast where there is a high amount of support vessel traffic, such as Grand Isle, Louisiana.

Conclusion

Impacts from OCS oil and gas operations associated with Sale 123 on coastal water quality would be moderate in a few locations along the coast that would be impacted due to high support vessel traffic or shuttle tankering operations and would be high in a few locations due to large amounts of produced water discharged into confined areas. Chronic, long-term degradation of water quality is occurring to a low extent due to spills less than or equal to 50 bbls. The impacts would be low.

Cumulative Analysis

The cumulative analysis considers the effects of routine or chronic accidental discharges, nonpoint source discharges such as surface runoff from land, hydrocarbon and chemical spill incidents, atmospheric fallout, rainout, and natural seepage entering the coastal waters of the CPA. These discharges could occur from the proposed action plus those related to past and future OCS oil and gas development activities, State oil and gas development activities, urban and agricultural expansion, municipal and industrial wastes, recreational and commercial boating, a multitude of marine transportation, and natural events. Section IV.A.2. presents information on major activities occurring in the Gulf.

The number of new onshore support facilities needed to aid all OCS oil and gas activities expected in the next 34 years includes two new service bases, two more pipelines going ashore, and one marine terminal (Table IV-1). Both these facilities and use of existing facility network would substantially increase the number of effluents expected to be discharged into coastal waters. Construction activities for the new service bases and marine terminals would impact localized water quality in the short term (Sections IV.A.3.a., e., and f.).

State oil and gas activities are expected to continue to expand. The network of 14,384 pipeline canals and the 7,880 miles of navigaton channels supporting both the State and Federal oil and gas system would continue to cause sediment erosion, saltwater intrusion (due to new canals or the redredging of existing canals), and water movement within the marsh and, therefore, water quality problems in coastal Louisiana.

Produced waters discharged from both Federal OCS and State oil and gas activities would be substantial and could have a significant impact at most of the discharge sites. Total amounts of OCS produced waters expected to be discharged into coastal waters are 19.6 billion bbls, or 1.58 million bbls per day, from OCS activities (38% of total OCS-projected produced water). An unknown but substantial amount would also be discharged from State oil and gas activities. Impacts from produced waters are discussed in Section IV.A.3.a.

Shuttle tankering will carry 22% of the oil produced ashore. It is estimated that 184 shuttle tanker trips from offshore facilities to shore-based terminals will occur during peak years of production. Other service vessels carrying personnel and supplies will make an estimated 26,270 trips to shore per peak year (Table IV-1). The Base Case analysis describes the types of impacts expected from support vessel traffic.

As part of NOAA's Status and Trends Program (Texas A&M University, 1988), the water quality along the Gulf of Mexico was examined to determine the long-term temporal and spatial trends of contaminant concentrations in bays and estuaries. The following results are from Years I and II of the sampling and from previous studies. Trace metals, PAH's, pesticides, and PCB's were analyzed in sediments and oysters. Sampling sites chosen were away from known point sources of contaminant input. The results of the study examining PAH's is presented above in the preceding impact analysis. The following discussion summarizes the remaining report. Moderately elevated concentrations of pesticides and PCB's were measured along the central Louisiana coast. Trace metal concentrations showed a great deal of variability, and oysters around central Louisiana exhibited lower concentrations of silver, cadmium, and copper than expected. Coprostanol, a chemical representing human or animal waste, was detected in all sites sampled. In particular, tributyltin was measured in bivalves to determine the extent of contamination in the Gulf of Mexico. Tributyltin is a major component of many antifouling paints used on marine boats, vessels, and tankers. Only recently has it been studied as a new potential environmental contaminant because of its toxicity to marine organisms. Oysters and mussels sampled were in most instances contaminated with tributyltin and its derivatives.

Tributyltin has recently been regulated to decrease the total amounts released into the environment from marine paints. Although it is expected to slow environmental loadings, some amounts will still be entering the marine environment. Monitoring programs will be established to determine how harmful these reduced quantities will be.

Section IV.A.2. presents a discussion of the major sources of oil contamination in the Gulf. Large spills from import tankering represent the greatest threat to coastal water quality. There is greater than a 89% probability of one or more large spills occurring from import tankers while at sea and contacting land (mean number of spills is 2.2) (Table IV-7). Large spills from OCS development occurring due to past sales, Sales 123 and 125, and all future OCS sales, plus import tankering operations, increase the probability of that at least one large spill would contact land to greater than 99% (mean number 5.5) (Table IV-7). Large spills from import tankers while in the coastal areas present even a greater threat. There is up to a 98% probability of one or more large spills occurring from import tankers while near a port. The mean estimated number of occurrences for the CPA port areas is 6.9 large spills. Small spills from OCS operations contribute a small but continuous, chronic level of oil to the coastal waters (Section IV.B.2.). For a discussion of the extent of chronic petroleum contamination presently existing in the Gulf coast area, see the previous impact analysis. These large oil spillage incidents and chronic small inputs impact water quality but are overshadowed by the input of the Mississippi River. Clearly, the major source of oil contamination of Gulf waters is the contaminated waters coming down the Mississippi River (78%) (Section IV.A.2.c.). This conclusion is supported by a number of major studies conducted in the Gulf of Mexico, including the MAFLA study, the Buccaneer Oil Field Study (Bedinger, 1981), and the Southwest Research Institute Platform Study (Middleditch, 1981). The Mississippi River also carries both nonpoint source runoff and point source discharges from industrial, municipal, and agricultural industries along or near its levees. The plume contains high amounts of sediments and organic chemicals, trace metals, and pesticides, which interact with the coastal and nearshore waters of Louisiana and Texas.

Conclusion

The level of cumulative impact on coastal/nearshore water quality is estimated to be high, primarily due to industrial and agricultural runoff, boating and marine activities, and the influx of contaminants coming down the Mississippi River.

High Case Analysis

No further expansions of onshore support facilities are expected due to the increased amount of oil found. Produced water discharges would approximately double being 1.08 billion bbls (38% of total formation waters discharged) (Table IV-1). As noted in Table IV-7 under the High Case, the OSRA model indicates up to a 10% chance of a large oil spill occurring and contacting sheltered waters (bays and marshes) in the CPA. The assumed number of small spills were approximately double. Support vessel traffic and shuttle tankering also doubles. Effects of support vessel traffic and produced waters are described under the Base Case analysis and are expected to be moderate in the number of localized areas along the coast.

Conclusion

The impact to coastal/nearshore water quality is expected to be moderate, mainly due to the increased locations expected to receive moderate impacts from vessel traffic and produced water discharges.

(b) Offshore

Base Case Analysis

The description of impacts to offshore water quality in the Central Gulf is hereby incorporated by reference from Final EIS 118/122 (USDI, MMS 1988c, pages IV-90 through IV-93). Presented below is a summary of that material.

Potential water quality degradation resulting from increased offshore OCS oil and gas operations will be governed by several factors which include the resuspension of bottom sediments through exploration and development activities, structure removal operations, and pipeline construction; the discharge of deck drainage, sanitary wastes, and domestic wastes; the discharge of formation/produced waters; the discharge of drilling fluids and muds; and accidental hydrocarbon discharges due to spills, blowouts, etc. These factors are more thoroughly discussed in Section IV.A.3.

Under the proposed Base Case, the discharge of up to 1.46 million bbls of formation/produced waters, 2.28 million bbls of drilling muds, 0.26 million yds^3 of drill cuttings, and an average of 105,000 gallons per day of treated sanitary domestic wastes from platforms may be expected (Table IV-1). Pipeline-related activities would result in the disturbance of up to 0.75 million yds^3 of sediment under the same scenario.

Dilution is extremely rapid in offshore waters to the extent that every substance measured in the water column, including turbidity, is at background by a distance of 1,000-2,000 m. For a more detailed discussion of drilling fluid/cutting discharges on the marine environment, see Section IV.A.3. The major effect is smothering, which is limited to within 300 m of the discharge point. Turbidity and toxicity are considered to be of minor consideration.

Table IV-5 indicates a 21% chance of one or more large oil spills (1,000 bbls or greater) from all OCS sources occurring in the Central Gulf as a result of the Base Case proposal; thus, it is assumed that a spill will, in fact, affect offshore water quality. Furthermore, it is estimated that one small spill of > 1 and ≤ 50 bbls will occur each year and that one spill of > 50 and < 1,000 bbls will occur during the 34-year lease life (Section IV.B.2.). Petroleum hydrocarbons introduced into marine waters as a result of a spill may have some effects on local water quality, depending on weathering and the local physical and meteorological parameters. As discussed in Section IV.B.3., normal weathering processes encountered with oil spilled into open water conditions tend to render the spilled oil less toxic by breaking down many of the toxic components of the oil.

Contaminants from shuttle tankering activities may enter the Gulf as a result of routine operational discharges or as a result of accidental spills. Of prime concern would be problems related to the movement of crude oil and offshore loading practices, where the potential exists for accidental spills to occur. Of the total 21% chance, 7% is estimated to be due to shuttle tankering operations.

Immediate effects would be brought on by increased drilling, construction, and pipelaying activities, causing an increase in water column turbidities of the affected waters.

The discharge of an average of 105,000 gallons per day of treated sanitary wastes from rigs and platforms will increase levels of suspended solids, nutrients, chlorine, and biological oxygen demand (BOD) in a small area near the point of discharge, which are quickly diluted.

Produced water is by far the largest quantity of waste to be discharged during normal oil and gas operations. The majority of these waters will be discharged directly to the surface waters surrounding the individual platforms. Some degradation (change) of the water quality will occur in the immediate vicinity of such discharges. However, these changes are not measured at distances greater than 1,000 m from the discharge, and no impacts on biota have been documented due to produced water discharges.

In addition, the natural condition of seawater may be altered in several ways during structure removal activities. These include the resuspension of bottom sediments, the discharge of solids and liquids generated by removal and transportation operations, and the generation of explosion by-products. These are discussed in Section IV.A.3.j.

Overall, offshore water quality degradation will occur within the immediate vicinity of exploration and production sites with high impacts expected to occur within a few meters to tens of meters from the discharge source. These impacts, however, will decrease to very low with distance (500-1,000 m) from the source.

Conclusion

As a result of the proposed action, the impact to offshore water quality in the Central Gulf is expected to be low.

Cumulative Analysis

The cumulative impact producing factors include those related to the proposed action plus those related to the Western Gulf proposed action, prior OCS sales, future OCS sales, State oil and gas activity, tankering and other vessel traffic, and industrial waste disposal activities that may occur and adversely affect offshore water quality in the same general area that may be affected by OCS oil and gas activity located in the CPA. Specific types of impact producing factors considered include well drilling discharges, pipeline emplacement, produced water discharges, dredging, accidental oil spillage, routine operational discharges, ocean disposal of hazardous material, and industrial waste discharges. A discussion of the non-OCS activities may be found in Section IV.A.2.

Under the cumulative scenario, the discharge of up to 51.51 billion bbls of formation waters, 39.04 million bbls of drilling muds, 4.38 million yds^3 of drill cuttings, and an average of 1.197 million gallons/day of treated sanitary and domestic wastes from platforms (Table IV-1). Pipeline-related activities could result in the disturbance of up to some 15.6 million yds^3 of sediment. Offshore waters will, therefore, be subject to cumulative impacts from discharges of drilling fluids, formation waters, and other effluents which add burdens of both toxic and nontoxic materials to the water column. However, the natural processes of dispersion, degradation, and sedimentation will result in immeasurably low concentrations of these materials within a few meters to a few kilometers of the discharge site, resulting in low regional impacts.

Under this analysis, there is a 99+% chance for one or more large oil spills (1,000 bbls or greater) occurring in the Central Gulf, based on the OSRA (Table IV-5). Based on the high percent chance of a large oil spill, it is assumed that there will be at least one spill which will, in fact, affect offshore water quality. Such a spill will impact more than a small local area near the source of the spill; in addition, the effects of the spill (higher than normal hydrocarbons and trace metal levels in the water column) are likely to persist for several weeks. Furthermore, it is estimated that a moderate number of spills of > 1 and ≤ 50 bbls will occur each year and that a few spills > 50 and < 1,000 bbls bbls will occur during the 34-year lease life (Section IV.B.2.). For a discussion on the fate of spilled oil, see Section IV.B.3.

Another concern relates to the movement of crude oil and offshore loading practices where the potential exists for spills to occur.

Conclusion

The level of cumulative impact on offshore water quality due to the high probability of a large oil spill is estimated to be moderate.

High Case Analysis

Under the High Case, the discharge of up to 2.83 million bbls of formation/produced waters, 3.87 million bbls of drilling muds, 0.43 million yds^3 of drill cuttings, and an average of 210,000 gal/day of treated sanitary and domestic wastes from platforms may be expected as a result of this scenario (Table IV-1). Pipeline-related activities would result in the disturbance of up to 1.5 million yds^3 of sediment.

Offshore waters will be subject to impacts from discharges of drilling fluids, produced waters, and other effluents which add burdens of both toxic and nontoxic materials to the water column. These quantities are much higher than those estimated for the Base Case; however, the natural processes of dispersion, degradation, and sedimentation will result in immeasurably low concentrations of these materials within a few meters to a few kilometers of the discharge sites, resulting in moderate impacts.

Under this analysis, there is a 37% chance of one or more large oil spills (1,000 bbls or greater) occurring in the Central Gulf, based on the OSRA (Table IV-5) thus, it is assumed that such a spill will, in fact, affect offshore water quality. Furthermore, it is estimated that a few spills of > 1 and ≤ 50 bbls will occur each year and a that few spills of > 50 and < 1,000 bbls will occur during the 34-year lease life (Section IV.B.2.). For a discussion on the fate of spilled oil, see Section IV.B.3. A discussion on the effects of spilled oil can be found in Section IV.B.6. of Final EIS 118/122.

As noted previously, contaminants from shuttle tankering activities may enter the Gulf as a result of routine operational discharges or accidental spills. Primary concern relates to the movement of crude oil and offshore loading practices, where the potential exists for accidental spills to occur. Of the total 37% chance, 13% is estimated to be due to shuttle tankering operations.

Conclusion

The impact to offshore water quality is expected to be low.

(4) Impacts on Air Quality

The major impact producing factors on air quality from OCS-related activity are due to combustion, evaporation, or venting of hydrocarbons. In the offshore environment, potential impact producing activity includes catastrophic events and operational emissions.

In the onshore environment, potential impact producing activity includes the operation of oil refineries, gas processing plants, and vessel offloading. These are discussed further in Section IV.A.3.

Definitions of the five expected levels of impact related to air quality are listed in Table S-4. Significant pollutant concentrations relative to these definitions are detailed in Tables IV-13 and IV-14.

Table IV-13

Increases in Ambient Air Pollutant Concentrations
for USDI Significance Levels

Pollutant	(ug/m^3)	Averaging Time
SO_2	1/5/25	Annual/24 hr/3hr
TSP	1/5	Annual/24 hr
NO_2	1	Annual
CO	500/2,000	8 hr/1 hr
VOC*	--	1 hr

Note: To achieve a level of significance, these concentrations must be exceeded by a facility.

*If VOC emissions are calcualted to be greater than the result of multiplying 33.3 times the distance in statute miles to the nearest shoreline, then these emissions are considered significant.

Source: 30 CFR 250.57.

Base Case Analysis

The analysis of the impact of OCS activities on air quality relies to a large extent on the regulatory framework established by the Clean Air Act, as amended (P.L. 95-11). This Act is designed to protect the public health of individuals and the welfare of the natural environment as it pertains to air resources. Title I of this Act sets forth air quality standards for human health (primary standards) and the welfare of the natural environment (secondary standards). Primary standards are for the protection of the physical well being of people and secondary standards are for the protection of the natural environment, which includes plants and animals. Reference to National Ambient Air Quality Standards (NAAQS) in this document includes both primary and secondary standards.

The ambient onshore air quality adjacent to the CPA is generally considered better than the national standards with violations of the NAAQS occurring in some coastal areas; these areas where violations occur are designated as nonattainment areas. Additionally, there is one PSD Class I area in the coastal region (Breton Wilderness Area) whereby a small amount of degradation to ambient air quality is considered significant. All nonattainment and PSD Class I areas in the CPA are identified below:

St. John the Baptist, Louisiana
  Nonattainment - Primary - O_3
Orleans, Louisiana
  Nonattainment - Primary - O_3
Jefferson, Louisiana
  Nonattainment - Primary - O_3
St. Bernard, Louisiana
  Nonattainment - Primary - O_3

St. Charles, Louisiana
  Nonattainment - Primary - O_3
Lafourche, Louisiana
  Nonattainment - Primary - O_3
St. Mary, Louisiana
  Nonattainment - Primary - O_3
St. Bernard/Plaquemines, Louisiana
  PSD Class I - Breton Wilderness Area

Table IV-14

Ambient Air Increments for PSD Areas
Maximum Allowable Increase
(micrograms per cubic meter)

Class I

Pollutant	
Particulate matter:	
Annual geometric mean	5
24-hr maximum	10
Sulphur dioxide:	
Annual arithmetic mean	2
24-hr maximum	5
3-hr maximum	25

Class II

Particulate matter:	
Annual geometric mean	19
24-hr maximum	37
Sulphur dioxide:	
Annual arithmetic mean	20
24-hr maximum	91
3-hr maximum	512

Class III

Particulate matter:	
Annual geometric mean	37
24-hr maximum	75
Sulphur dioxide:	
Annual arithmetic mean	40
24-hr maximum	182
3-hr maximum	700

Sources: 40 CFR 52.21 and 30 CFR 250.57.

In the CPA, national air quality standards are exceeded in the above listed areas for ozone. Mobile County, Alabama, was redesignated as attainment for ozone in 1987. This has reduced the overall number of nonattainment areas in the CPA.

The Louisiana Department of Environmental Quality (DEQ) is considering the coastal parishes of St. Bernard, Orleans, Jefferson, St. Charles, and Lafayette Parishes for redesignation as attainment areas for ozone. Redesignation is based on three consecutive years of monitoring the parishes in question. The results of the monitoring program must show the national standards have been met each year for redesignation to occur. In November 1988 DEQ reported an application to redesignate St. John the Baptist Parish as an attainment area for ozone. A determination on this application by USEPA is expected in 1989.

Onshore, it is expected that no new gas processing plants and no new crude oil refineries will be needed to handle resources produced as a result of this proposed sale. Offshore, 210 exploration and delineation wells, and 290 development wells are estimated to be drilled and 25 additional production platforms utilized (Table IV-1).

Offloading of crude oil transported by surface vessel (on the Gulf of Mexico almost exclusively by barge) at coastal ports currently includes less than 3% of OCS production. Measured fugitive emissions from offloading operations are unknown, but the amount of hydrocarbons emitted is considered negligible (Von Bodungen, 1988) in the CPA. Safeguards to ensure minimal emissions from offloading and loading operations have been adopted by the Louisiana DEQ. Projected deepwater sale-related production would indicate that a substantial increase in barging is likely. Current industry practice based on economic consideration is to extend pipelines to new production when feasible. Barging new production to the nearest piepline-equipped platform (if not available, then to the nearest coastal terminal) is required until the pipeline network is expanded. Engine emissions from tug boats and other service vessels are created by these power boats. These emissions are temporary, mobile, and random in time and space. They are expected to produce a negligible effect on air quality.

Catastrophic events such as major oil spills and blowouts have the potential to create localized air quality problems. It is estimated that 45% of a typical large Gulf of Mexico oil spill is expected to be lost due to evaporation of hydrocarbons over the first 10 days. There is a 5% chance of one or more large oil spills (1,000 bbls or greater) occurring and contacting land as a result of the proposed action; the estimated mean number is 0.1 (Table IV-7). Should a large oil spill occur, it is estimated that the likely long-term effect on onshore air quality would be negligible. The probable distance from shore (more than 3 miles and very likely farther), rapid dispersion or breakup associated with oil spills, and the turbulent variable surface winds offshore are conditions that minimize oil spill effects. Rapid dispersion of evaporative emissions from these sources is expected. Catastrophic events are not possible to predict in time and location. Effects from these nonroutine activities are highly dependent on the distance offshore, climate conditions at the time, and proximity to a nonattainment or PSD area. Higher impacts may occur if these events affect nonattainment or PSD Class I areas (see Section IV.A.3.b. for further discussion).

In an attempt to estimate the amount of operational emissions produced as a result of Sale 123 for an average year of activity, air emissions data were compiled for exploratory drilling and platform operations. Typical emissions for exploratory drilling are shown in Table IV-15 and are based on studies conducted by USEPA for offshore activities. Emissions for a major platform operation is presented in Table IV-16. Emissions shown in this table are based on data compiled from the 1987 air emissions inventory in the Gulf of Mexico.

Table IV-15

Typical Emissions for Exploratory Drilling Activity[1]
in the Gulf of Mexico
(tons)

NO_x	CO	SO_x	VOC	TSP
10.3	1.51	0.69	0.34	Unknown

[1] Assumes: 10,000' hole; 597,120 hp/hr diesel-fired reciprocating engines; and a 30-day period.

Source: U.S. Environmental Protection Agency, 1985.

Table IV-16

Average Annual Emissions from a Production Platform
in the Gulf of Mexico
(tons/year/platform)

NO_x	CO	SO_x	VOC	TSP
85.75	11.17	0.152	32.50	0.21

Source: USDI, Minerals Management Service, Gulf of Mexico OCS Region.

An average annual amount in tons/year is given for each activity and pollutant along with a total average for the proposed action. Computing the average requires estimating emissions for all operational activities. This allows for an accounting of emissions for both drilling and production. It is recognized that all activities do not occur at the same time. Drilling work is predominant in the early phases of exploration and development while platform production expands gradually throughout the operating period. As production activity increases, drilling activity decreases. It should be noted that the total emissions estimated in Table IV-17 are based on values provided in Tables IV-15 and IV-16.

Table IV-17

Average Annual Air Emissions Under Base Case Assumptions
Central Planning Area
(tons/year)

	NO_x	CO	SO_x	VOC	TSP	Number of Wells/ Platforms	Operations Period in Years
Proposed Action							
Exploratory Drilling	196.6	28.8	13.2	6.5	---	210	11
Development/Production Drilling	106.9	15.7	7.2	3.5	---	270[1]	26
Platforms[2]	2,447.3	323.8	24.2	822.5	5.3	25	
Total	2,750.8	368.3	44.6	832.5	5.3		

[1] Excludes subsea completions.
[2] Assumes all platforms are major platforms capable of producing emissions.

Source: Table IV-1.

It is projected that 25 platforms may result from this proposed sale. The platforms will be distributed throughout the CPA and will tend to be located farther offshore than existing platform locations due to trends in resource discovery locations. The effect of emissions from these platforms on air quality is expected to be negligible. This expectation is based on recent modeling of emissions from 195 point sources nearshore in the CPA. This modeling study is described in the cumulative analysis of this subject resource. The result of this study is shown in Table IV-20 and is drawn from a study area with densely-located platforms close to shore. It is inferred that emissions from 25 widely dispersed platforms in the CPA resulting from proposed Sale 123 will be no greater than those modeled. Use of the OCD Model for the projected 25 new platforms is not possible due to limitations of the model program and to the meteorological data requirements of the program.

Table IV-18

Summary of Expected Impacts on Air Quality-Proposed Action
Central Planning Area

Major Impact Producing Factor	Expected Impacts Onshore	Duration of Expected Impacts
Offshore Activity		
Catastrophic Events		
Blowouts with fire	Very low to moderate	Short-term
Oil spills (major)	Very low to moderate	Short-term
Release of sour gas (nonflared blowout)	Very low to moderate	Short-term
Operational Emissions*		
Exploration drilling	Very low	Long-term
Platform installation	Very low	Long-term
Development drilling	Very low	Long-term
Oil production	Very low	Long-term
Gas production	Very low	Long-term
Barging	Very low	Long-term
Onshore Activity		
Operational Emissions*		
Refineries	No new expected	Long-term
Gas processing plants	No new expected	Long-term
Offloading	Very low	Long-term

*Impacts from these activities are maintained below an upper limit (moderate) due to standing regulatory controls.

Note: Specific changes in conditions relative to levels of impacts are defined at the beginning of this section. Short-term is less than one year. Long-term is more than one year.

The impact of OCS emissions resulting from the proposed action cannot be measured with available information. The spatial distribution of rigs and platforms, the temporal distribution over time, and the specific equipment producing emissions are unknown. However, it is assumed the proposed action is expected to create a relatively even distribution of activity throughout the Central Gulf with the greatest potential in subplanning area C-2 and the least potential activity in C-4. The number of wells drilled and platforms installed are estimated in Table IV-1. Emission controls or offsets are not expected to be necessary for offshore facilities.

Of these coastal parishes/counties adjacent to the majority of offshore development, the ones most likely to be adversely impacted by new activity due to their unique status as nonattainment or having PSD Class I areas are: St. John the Baptist, Orleans, Jefferson, St. Bernard, St. Charles, Lafourche, St. Mary, and Plaquemines Parishes, Louisiana. The expected levels of new activities adjacent to these parishes are not large. A trend toward development farther offshore is noted. Increased distances to shore will result in a greater dispersion of emissions. Activities are not expected to occur simultaneously and are not expected to cause impacts above the level defined as very low. Very low impacts can be based solely on the amount of activity expected to occur, i.e., nonattainment areas are unlikely to be degraded further.

Additionally, no significant deterioration of onshore air quality is expected from routine offshore operational emissions due to the regulatory control provided in 30 CFR 250.45(g). These regulations limit emissions from OCS facilities relative to significance levels outlined in Tables IV-13 and IV-14. The regulations require that individual analysis of emissions produced by proposed structures in the Gulf of Mexico be performed. Since 1980 this analysis has shown that no structure proposed to date will exceed the exemption level. These regulations ensure that impacts do not rise above an upper level (moderate) and will be considered insignificant. Impacts are controlled by regulations in this case such that the health of individuals and the welfare of the natural environment are protected at an acceptable level. Impacts from uncontrolled (nonroutine) events could be higher. Ozone (O_3) is not directly emitted by any OCS source. The expected duration of impacts and a summary of expected impacts on the resource of concern are presented in Table IV-18.

Conclusion

Impacts on St. Bernard, Plaquemines, St. Mary, Lafourche, St. Charles, Jefferson, and Orleans Parishes in Louisiana are estimated to be moderate due to the potential effects of catastrophic events. Very low impacts are expected to occur throughout the remainder of the coastal area of the Central Gulf and in Escambia County in the Eastern Gulf.

Cumulative Analysis

This cumulative analysis considers the effects of impact producing factors related to the proposed action plus those related to prior OCS sales, future OCS sales, State oil and gas activity, power generation, industrial activity, waste incineration, petrochemical processing and storage, vehicular and waterborne transportation, and other activities that may occur and adversely affect air quality in the same general area that may be affected by OCS oil and gas activity located in the CPA. Impact producing factors considered in the analysis are the routine emissions (point source and mobile) related to the above activities.

Point source emissions from onshore activities, such as non-OCS oil and gas processing, power generation facilities, industrial processing or manufacturing facilities, waste incineration facilities, petrochemical storage facilities and mobile emissions sources (automobiles, waterborne transportation, etc.), are expected to increase at rates in proportion to the growth of population. Energy conservation, improved automobile emission controls, alternative (non-fossil fuels) energy generation facilities, and new waste disposal technology are factors that will determine the rate of change in air quality. Regional population increases have occurred at a decreasing rate since 1970. A decreasing population in-migration is noted throughout the Gulf region. This fact supports the assumption that ambient air quality is not expected to degrade beyond attainment standards where it is currently better than those standards or where PSD areas are located. The effects of all emissions on areas presently classified as nonattainment should be reduced over time so that attainment standards will be met. Note the redesignation plans for Louisiana Parishes discussed above and the new attainment status for Mobile County, Alabama. Controls and offsets may be applied to onshore emissions sources to meet standards as needed.

The estimated OCS offshore emissions under the cumulative scenario are presented in Table IV-19. Estimates are included for emissions of NO_x, CO, SO_x, VOC, and TSP which would be generated by exploratory and development well drilling and routine platform operations. Existing platform distances to shore may range from 3 nmi to over 150 miles. Emissions for OCS installations are calculated at the time of permitting production facilities. Such factors as the distance to shore, climatological conditions, and emissions producing equipment on each platform is analyzed as to its contribution to degradation of air quality. Since records have been kept (June 1980), this air quality permitting analysis has identified a negligible contribution on an individual basis in the CPA.

Table IV-19

Cumulative OCS Offshore Air Emission Estimates
Central Planning Area

Offshore Infrastructure	Pollutant/Emission (1,000 tons)					Number of Wells/Platforms[1]
	NO_x	CO	SO_x	VOC	TSP	
Estimated to be Developed						
Exploration Wells Drilled	33.4	4.9	2.2	1.1	--	3,240
Development Wells Drilled	51.5	7.6	3.5	1.7	--	5,000
Subtotal	84.9	12.5	5.7	2.8		
Average Annual[2]	2.5	0.4	0.2	0.1		
Platforms						
Estimated to be Developed	24.4	3.2	0.1	9.2	0.0	285
Existing	89.1	11.6	0.2	3.3	0.2	1,040
Total Average Annual	116.0	15.2	0.5	12.60	0.2	

[1] The numbers of wells/platforms are taken from Table IV-2; except the number for existing platforms, which was derived by using only the number of platforms producing air emissions. Subsea completions are excluded.

[2] Based on a 34-year operating period.

OCS oil and gas activity occurs as a dynamic process that involves the spatial distribution of point sources operating over extended periods of time. Many factors may contribute to the quality of air at a given point in time and space. These factors include (1) the number, size, and location of point sources; (2) the nature of emissions generated at point sources; and (3) the meteorological conditions that exist over time. Each of these factors interacted with the other to produce air of a particular composition. Since this interrelationship is dynamic, the composition, or quality of air, may change at varying rates, i.e., minute by minute, hour by hour, etc. The analysis of air quality, therefore, requires a complex investigation not practical prior to the development of computer modeling.

A study of the cumulative effects of offshore operational emissions produced by OCS oil and gas activities was undertaken by the Gulf of Mexico OCS Region. The study required the inventory of offshore emissions Gulf wide and the selection of study areas. The criteria used to select the study areas included identifying the highest concentration of point sources (platforms) located the shortest distance from shore. The selection of areas with the least desirable environmental characteristics (from an air quality standpoint) would ensure the most conservative study results. Receptor points were located at the shore line adjacent to the study areas.

Through the use of the Offshore Coastal Dispersion Model (OCDM), conditions in eight study areas was simulated for one year. The geographic location of these study areas are shown in Figure IV-7. They are located offshore Louisiana west of the Mississippi River to near Grand Isle. The model, capable of simulating the cumulative effects downstream of up to 250 point sources under various climatological conditions, was run for nitrogen oxides (NO_x). Study Areas 1, 2, and 3 were run as separate units. Study Area 4 cut across portions of the first three study areas and serves as an OCS nearshore area. The succeeding study areas were added to the nearshore area to form new, larger areas. The results of these eight model runs are shown in Table IV-20.

The NAAQS for NO_x is a concentration not to exceed 100 micrograms per cubic meter (ug/m^3) averaged over one year. The highest concentration noted in Table IV-20 is 1.83 ug/m^3 for the composite Study Area Number 8

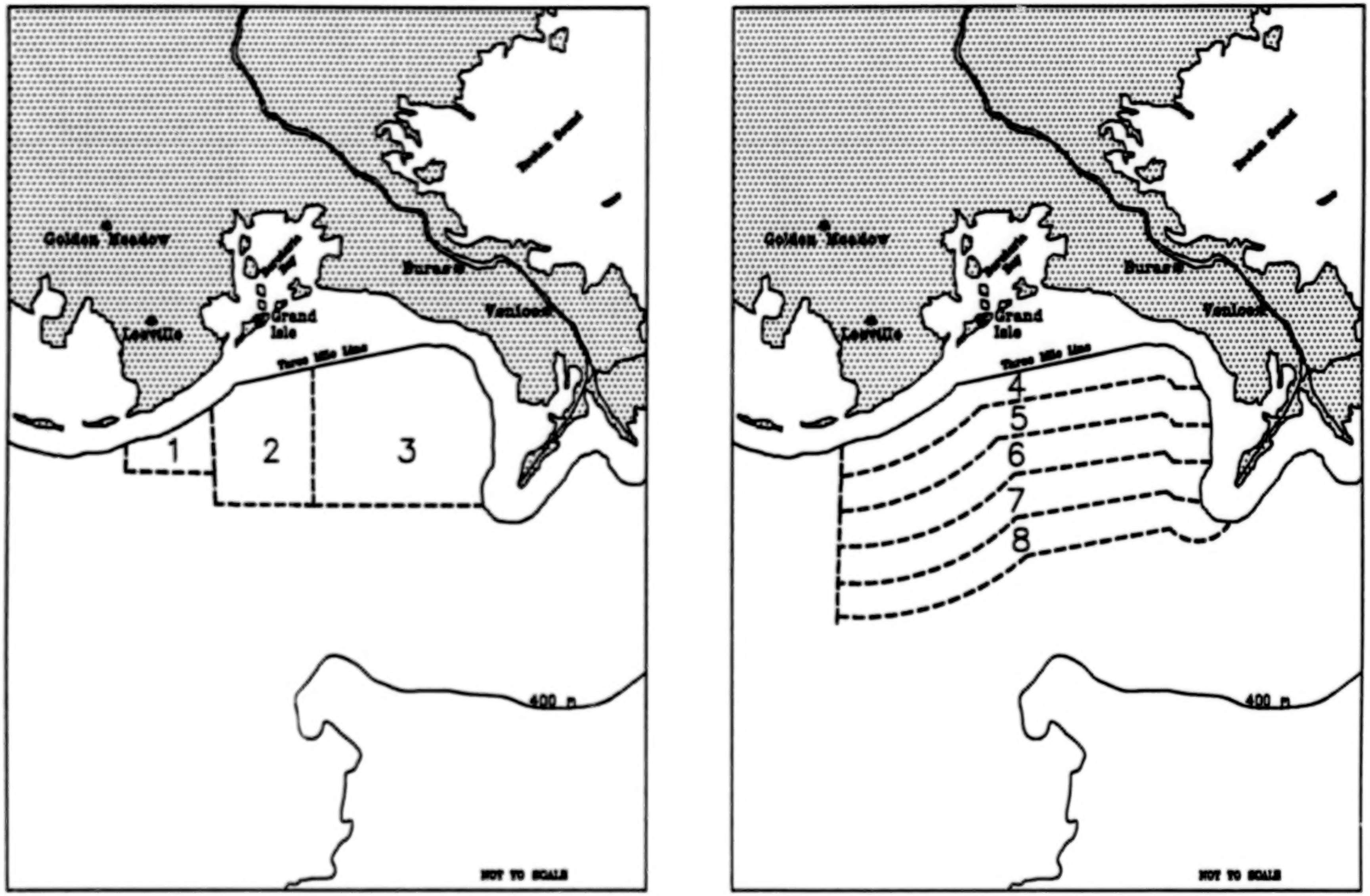

Figure IV-7: Gulf of Mexico Air Quality Areas for Modeling Inert Pollutants.

Table IV-20

Cumulative Concentrations of Nitrogen Oxides from OCS Operational Emissions in Selected Areas

Study Areas	Distance to Shore in Miles*	Point Sources	Receptor Points	Annual One Hour Average** Minimum	Maximum
1	3.5 - 8.7	48	17	0.48	1.20
2	3.5 - 18.0	41	21	0.12	0.53
3	3.5 - 24.8	81	26	0.35	1.06
4	3.5 - 8.0	63	30	0.24	1.01
4 and 5	3.5 - 13.0	95	30	0.59	1.48
4, 5, and 6	3.5 - 18.0	130	30	0.66	1.58
4, 5, 6, and 7	3.5 - 23.0	158	30	0.74	1.76
4, 5, 6, 7, and 8	3.5 - 28.0	195	30	0.82	1.83

*Statute miles.
**Micrograms per cubic meter.

Source: USDI, Minerals Management Service, Gulf of Mexico OCS Region.

with 195 point sources. This concentration is less than 2% of the NAAQS. It should be remembered that all other annual 1-hour averages are less than this value. The minimum concentrations are also shown in Table IV-20.

While the results of this modeling study show less than 2% of the NAAQ standards, in some instances emissions exceed the DOI's significance level of 1 ug/m^3 for one structure. If this level of impact were to occur as a result of this proposed sale, DOI regulations would require that best available control technology (BACT) be applied to platform emission sources.

The OCD Model analysis quantifies the cumulative effects of OCS operational emissions in an area that appears to have the potential to produce high impacts. The analysis, however, indicates no significant effects on air quality as a result of existing oil and gas operations within the study areas. It is reasonable to assume other offshore areas of the Gulf of Mexico region with less concentrated activity and greater distances to shore would produce no greater air quality impacts.

No new oil refineries, no new gas processing plants, and limited offloading activities are estimated to result from OCS activity under the cumulative scenario (Table IV-1). It is assumed that new source performance standards and best available control technology will be used on all onshore facilities and that additional controls or offsets may be required in some areas to meet air quality standards imposed by existing regulations. It can be assumed that impacts will be their highest (relatively) in the following parishes/counties which are clasified as nonattainment or PSD Class I areas: St. John the Baptist, Orleans, Jefferson, St. Bernard, St. Charles, Lafourche, St. Mary, and Plaquemines Parishes, Louisiana.

It must be noted that these areas identified are nonattainment areas for a specific pollutant (O_3). Gas processing produces specific SO_x emissions only. Therefore, these activities will not be a significant contribution to the identified parishes/counties, except that these activities may use an increment of the allowable SO_x limit.

Conclusion

The level of cumulative impact to air quality is estimated to be moderate.

High Case Analysis

Impacts are similar in type and only slightly greater in magnitude than those described for the proposed action. Under the High Case, no new refineries and gas processing plants are projected. It is expected that 310 exploration and delineation wells and 510 development/production wells will be drilled, and 50 platforms will be utilized (Table IV-1). New activity is expected to be unevenly distributed throughout the CPA.

Conclusion

Moderate impacts are estimated to occur in St. Bernard, Plaquemines, St. Mary, Lafourche, St. Charles, Jefferson, Orleans, and St. John the Baptist Parishes in Louisiana. Very low impacts are expected to occur throughout the remainder of the coastal area of the CPA and and Escambia County in the Eastern Gulf.

(5) Impacts on Endangered and Threatened Species

Definitions of impact levels are presented in Table S-4.

In accordance with Section 7(a)(c) of the Endangered Species Act of 1973, as amended, consultations on the proposed Gulf of Mexico OCS lease sales were initiated with FWS and NMFS in December 1988. The FWS biological opinion for proposed OCS Lease Sale 123 (Central Gulf) determined this proposed action does not represent a substantive modification of the proposed action considered in an earlier biological opinion (June 30, 1982; USDI, MMS, 1984d). The earlier biological opinion concluded that the direct and indirect proposed actions are unlikely to jeopardize the continued existence of the species considered in the biological opinion or to result in the destruction or adverse modification of their critical habitats.

The NMFS biological opinion for proposed Sale 123 is pending. Communications with NMFS (Henwood, 1988, personal communication) indicate the biological opinion for proposed Sale 123 will be similar to the previous biological opinion for Sale 115 with a similar conclusion and will reference the previous biological opinion. The previous NMFS biological opinion (Appendix B) addressed all phases of OCS oil/gas activities that have occurred or are proposed in the Gulf of Mexico. The NMFS concluded that the proposed action is unlikely to jeopardize the continued existence of any endangered or threatened species under their jurisdiction.

Section 9 of the Act prohibits the "taking" of any endangered fish or wildlife (to "take" means harass, harm, pursue, hunt, shoot, kill, trap, capture or collect, or attempt to engage in any such activity). The incidental taking (accidental unavoidable taking) of an endangered species is discussed under Section 7(b)(4)(B) of the 1982 amendments to the Endangered Species Act. This section allows for the issuance of an "incidental take statement" along with a biological opinion. This "incidental take statement" operates to exempt the Federal agency and any permit or license applicant involved from Section 9 "taking" prohibitions under the Act if the subsequent implementation of the action is consistent with the terms and conditions of the incidental take statement (Appendix B).

Of the endangered and threatened species discussed in Section III.B.3., the brown pelican and sea turtles (green, Kemp's ridley, and loggerhead turtles) are probably the species most vulnerable to OCS-related oil/gas impacts resulting from this proposed action. The following analysis also represents possible adverse impacts to other protected species.

(a) Brown Pelicans

Base Case Analysis

Normal activities and accidental events associated with OCS oil and gas development may have impacts on brown pelicans. These include acoustic and displacement disturbances, explosive concussion, contact with noxious chemicals, and collisions. Impact by entanglement or ingestion of debris and displacement disturbances of oil spillage appear to have the greatest potential for impacting brown pelican populations.

Noise and disturbances associated with the use of explosives, seismic exploration, and platform operations are unlikely to significantly affect brown pelicans because they occur away from the pelican's coastal habitat. However, the concussive effect of seismic exploration, and structure removal explosions may cause mortality of fish utilized by pelicans (Wingert, 1988). The dieoffs would be localized and short-term in areas not frequented by pelicans. The noise and disturbance associated with onshore support facilities, airborne and waterborne traffic, and pipeline construction have a greater potential for impacting pelicans than other OCS oil and gas activities because they occur in pelican habitat. No new onshore construction of this nature is planned by the proposed action. Offshore pipeline construction may cause resuspension of toxic chemicals during pipelaying. The toxins could be concentrated through the food chain, ultimately causing egg shell softening and deformities to pelicans. Such hazards are unlikely because of the minor disturbance to the sediments during installation. Noise and disturbances associated with vessel and flight traffic supporting offshore structures and with shuttling OCS-produced oil to port could cause abandonment of nests, excessive energy expenditures, and displacement to less suitable habitats. The proposed action has an estimated 21 shuttle tanker trips, 3,671 support vessel trips, and 6,662 helicopter trips during the peak activity year (Table IV-2). This represents a negligible amount of the total annual air and water traffic in the Gulf of Mexico. Though the rookery on Queen Bess Island is within the flight path and adjacent navigation channels, the proposed action is not expected to introduce or measurably elevate any existing impacts. Helicopter and vessel traffic also have the potential of colliding with brown pelicans. Though such events are rare, there is at least one documented report of an MMS inspection helicopter colliding with and killing a brown pelican.

Another potential hazard is the death or injury of pelicans from entanglement in plastic debris originating from OCS oil and gas platforms or support vessels. Pelicans may be particularly vulnerable to entanglement because their diving for food may be in areas where their prey seek shelter in debris (Centaur Associates, Inc. and Center for Environmental Education, 1986; Day et al., 1985). The MMS prohibits the disposal of equipment, containers, or other materials into offshore waters by lessees and contractors (30 CFR 250.90). In addition, Public Law 100-200 (101 Statute 1458) MARPOL, Annex V, which prohibits the disposal of any plastics at sea or in coastal waters, will go into effect January 1, 1989. Entanglement does not occur frequently enough to limit the regional population.

The discharge of drilling mud, cuttings, and produced waters could have an indirect impact on pelicans by adversely affecting their prey. Such impacts are likely to be short term and localized in areas not frequented by pelicans.

Spilled oil can impact brown pelicans by physical impairment, contact with toxics, habitat destruction, food contamination, and disturbances from oil spill response and cleanup efforts. The MMS (USDI, MMS, 1987b) and NAS (1985) provide a detailed discussion of each of these impacts. The brown pelican appears particularly vulnerable to oil spill impacts because of its small population and limited distribution in the Western and Central Gulf, tendency to congregate while feeding and roosting, time spent on the water, feeding behavior that entails diving into the water, and attraction to spills by the presence of asphyxiated fish on the surface. The ultimate impact and recovery of an oiled pelican depends on the physical and chemical composition of the oil, ambient conditions, and the state of the bird. It is assumed that freshly spilled oil contacting eggs, fledglings, and elderly or unhealthy birds for an extended period in cold, inclement weather is the worst scenario. Oiling can result in a bird's inability to fly, seek food, and thermoregulate. Inhalation of volatile components, though unlikely, could result in respiratory injury and asphyxiation. Ingestion by preening or consumption of contaminated fish may result in illness or reproductive failure.

In the Base Case analysis, there is a 2% probability of a large oil spill (1,000 bbls or greater) occurring and contacting the Queen Bess Island rookery, a 1% probability of a contact with the Last Island rookery, and less than a 0.5% probability of a contact with the North and Gaillard Island rookeries. Based on the OSRA model it is likely that if a large oil spill occurred it would not contact pelican rookeries in the Central Gulf. As discussed above, the effect of such a contact is highly variable. Other previously mentioned impacts may also compound the effects of oiling. Observations of brown pelicans during the Puerto Rico and Apex Houston spills off the California coast where less than 1% of the local population were observed with oiled plumage, suggesting that they exhibit an avoidance reaction (USDI, MMS, 1987c). Oil spillage, as an indirect effect on pelicans by contaminating their food consumption of contaminated fish, could have a high local mortality, but this is unlikely to significantly reduce the regional population. Oil spillage of less than 1,000 bbls per incident are likely to occur as a result of the proposed action. It is assumed that there will be one spill per year for spills of > 1 and ≤ 50 bbls and one spill per 34 years for spills greater > 50 and < 1,000 bbls. A few spill incidents between > 1 and ≤ 50 bbls are assumed to contact the coastline sometime during the 34-year lease life, while no spills > 50 and < 1,000 bbls are assumed to contact the coastline during the 34-year lease life. The impacts of smalls spills are similar to those discussed above for large spills. Small spills may have greater sublethal and long-term impacts on fecundity because of their chronic nature (Deiter, 1977). However, small spills are less likely than large spills to contact the coastal areas frequented by pelicans.

Conclusion

A population decline caused by OCS oil and debris is not expected to last more than one generation. The impact is estimated to be low.

Cumulative Analysis

The cumulative analysis considers the effects of impact producing factors related to the proposed action plus those related to prior and future OCS sales, State oil and gas activity, crude oil imports by tanker, and other commercial, military, and recreational offshore and coastal activities. These activities may result in collisions, displacement, entanglement or contact with toxic substances; loss of habitat; and reduction of available food. Collision with or displacement by airborne or waterborne traffic is unlikely in the Central Gulf because of the small pelican population. The greatest hazard is in Queen Bess Island rookery in the Barataria Basin of Louisiana. Even in this area, impacts are expected to be low because of the protection of the rookery by resource agencies and the lack of evidence that traffic will increase significantly. Entanglement in or ingestion of plastic discarded by oil and gas operators, waterborne commerce, fishermen, or municipalities is potentially lethal to individuals, but it is not significant to the regional population. Land development will continue in the coastal areas of the CPA (Table IV-2); however, it is unlikely to significantly impact the brown pelican because much of its nesting and roosting habitat is undeveloped public land and its protected status requires private land owners to mitigate habitat losses.

Oil spillage has the greatest cumulative potential for harming pelicans. There is a 63% probability of a large oil spill (1,000 bbls or greater) occurring and contacting the Queen Bess and Last Island rookeries as a result of OCS sales and crude oil imports. The Gaillard and North Island rookeries have a 19% and 17% probability, respectively, of being contacted. Cumulatively, a moderate number of spills (> 1 and ≤ 50 bbls) are assumed to occur each year. A few will occur in coastal environments and contact the coast each year. A few spills of > 50 and < 1,000 bbls will occur annually, only a few of which will contact the coast within the lease life. Although most small spills occur offshore in areas less frequented by pelicans, their chronic nature may result in a long-term, greater frequency of contact than large spills. The frequency of large and small spills suggests that population declines lasting about one generation could result. Contamination of food by oil spillage, storms, hurricanes, and other natural destructive events could cumulatively cause death or injury to several individuals, but it is unlikely to significantly impact the regional population. Based on the lethal and sublethal effects of spilled oil contacting pelicans and the probability of such a contact occurring, the resultant population decline will last one generation.

Conclusion

The cumulative impact is moderate.

High Case Analysis

The High Case is an optimistic estimate of development and production for the proposed action. The barrels produced, shuttle tanker traffic, the number of platforms, and the miles of offshore pipeline in the High Case are approximately double that of the Base Case (Tables IV-1 and IV-2). The increase in activities and production is accompanied by greater risk of adversely impacting brown pelicans by disturbance and oil spillage. As in the previous analyses, disturbances are unlikely to be significant because most activities are carried out away from pelican habitat. Oil spillage, potentially the greatest threat, would double in volume and occurrence. The Queen Bess and Last Island rookeries have a 3% probability of being contacted by one or more large oil spills. The other rookeries have less than a 0.5% probability of being contacted in this scenario (Table IV-7). Doubling the spillage volume and occurrence should not result in impacts greater than the Base Case. Vessel and air traffic would also increase, though not at the two fold rate of production. Traffic would continue to have a low impact on brown pelicans because of its negligible contribution to the total traffic in the Gulf and the improbability of interaction with pelicans. As in the Base Case, no new onshore support facilities would be built that would displace pelicans. Based on a negligible increase in the contact with traffic and sources of disturbance, the avoidance of spilled oil by pelicans, the low probability of an oil spill contact, and the lethal and sublethal effects of spilled oil contacting pelicans, a resultant population decline is expected to last less than one generation.

Conclusion

The impact under the High Case is estimated to be low.

(b) Sea Turtles

Base Case Analysis

Normal OCS activities and accidents could adversely impact marine turtles. The normal activities with the greatest likelihood of impact are tanker and shuttle vessel traffic, the use of explosives, and coastal development. Turtles resting or swimming at the surface are susceptible to being struck by vessels. These collisions would probably be fatal. Although collisions appear to be common, the traffic associated with the proposed action is unlikely to result in a population decline lasting longer than one generation because of its negligible contribution to the total vessel traffic in the Gulf of Mexico.

Explosives are frequently used to remove structures, but rarely as a seismic source. The use of explosives could pose a threat to marine turtles. Turtles within 1,000 yards of a 200-lb nitromethane explosion experienced capillary damage, disorientation, and loss of motor control (Duronslet et al., 1986). Explosives were used in 58% of the structure removals between November 1986 through June 1988. The MMS observers at 17 of these removals sighted three turtles, none of which were injured by the removal operations. The proposed action will install approximately 30 structures, which will probably be removed within 25 years. The MMS guidelines regarding charge size/spacing and turtle detraction are expected to mitigate potential injury (Section IV.A.3.j.). Injury or death resulting from an explosion could affect a small number of individuals but these losses are unlikely to affect the regional population.

Entanglement in or ingestion of debris originating from platforms or support vessels can cause drowning, injury, digestive disorders or reduced mobility resulting in starvation. Analysis of stomach contents of necropsied stranded sea turtles indicated that 30%-50% of the victims had ingested plastic (Interagency Task Force, 1988). The MMS (30 CFR 250.40) and Public Law 100-220 (101 Statute 1458), MARPOL, Annex V, prohibit the disposal of plastics at sea or in coastal waters. Debris originating from the offshore oil and gas industry are unlikely to kill or injure any sea turtles. Oil spillage can affect sea turtles by toxic contact, ingestion, inhalation, and excessive expenditure of energy. Boesch and Rabalais (1987), Vargo et al. (1986), and Fritts and McGehee (1981) discuss these impacts in detail. Turtle eggs exposed to oil have resulted in hatchling deformities. Carr (1986) suggested that "lost year" turtles are most likely to contact oil because the currents that form the debris mats, which this life stage inhabits, also direct and concentrate spilled oil. These juveniles also ingest tar balls; such consumption frequently results in blockage of the digestive or respiratory system (Vargo et al., 1986). Although death from ingestion of OCS oil is possible, most oil produced in the Gulf of Mexico does not form tar balls because of its low asphaltine component (Section IV.B.3.). Adult turtles display an avoidance of spills by increased dive time and by swimming away from the oil (Maxwell, 1979; Vargo et al., 1986). Oil spillage can also indirectly affect turtles by contamination of their food, which results in a scarcity of food or bioaccumulation of toxins. There is a less than 0.5% probability of a large oil spill contacting the sea turtle nesting beaches on Louisiana, Mississippi, and Alabama barrier islands, and a 3% probability of contacting the turtle foraging areas west of the Mississippi River delta (Table IV-7). Oil spillage of less than 1,000 bbls per incident is likely to occur as a result of the proposed action. It is assumed that there will be one spill per year for spills of > 1 and ≤ 50 bbls and one per 34 years for spills > 50 and < 1,000 bbls. A few spill incidents > 1 and ≤ 50 bbls are assumed to contact the coastline sometime during the 34-year lease life, while no spills > 50 and < 1,000 bbls are assumed to contact the coastline during the 34-year lease life. Based on the OSRA model, it is likely that if a large oil spill occurred it would not contact sea turtles in the Central Gulf. Small spills contacting turtles will have similar impacts; however, their size makes them more easily avoided and thereby less threatening. The absence of onshore construction, the absence of reported collisions, the low probability of collisions, the mitigating measures deployed during the use of explosives, the avoidance of oil, and the improbability of a contact with oil suggest that a population decline would last less than one generation.

Conclusion

The impact is estimated to be low.

Cumulative Analysis

Collisions with vessels will probably increase with the amount of traffic in the Gulf. Entanglement, especially in shrimp trawls should be reduced by legislation prohibiting the disposal of debris at sea and the use of turtle exclusion devices. Nesting areas will remain unimpacted by development because of their location on recreational public lands. The use of explosives may increase as the structures in the Central Gulf age. This increased hazard should be mitigated by the development of nonexplosive removal techniques and the explosive removal guidelines discussed above (Section IV.A.3.j.).

Cumulatively, there is a 82% chance of a large spill originating in the CPA and contacting the turtle foraging areas west of the Mississippi delta off the Louisiana coast. Nineteen percent of the contacts are attributable to imported oil in tankers; the remainder are based on past, present, and future OCS sales. There is also an 18% probability of a large spill occurring and contacting the turtle nesting beaches on the Louisiana, Mississippi, and Alabama barrier islands. Imported oil contributes 12% to this spillage, with the remainder coming from OCS activities (Table IV-7). Imported oil has a higher percentage of asphaltene components than OCS-produced oil; this makes it more likely to produce tar balls, which could be ingested by turtles. The OSRA model and imported oil spill rates suggests that if a large spill occurred it would contact one or more sea turtles in the Central Gulf. A moderate number of small spills of > 1 and ≤ 50 bbls will occur each year. A few will occur in proximity to coastal resources (greater than 1 per year) and a few will contact the coast each year. A few spills of > 50 and < 1,000 bbls will occur each year; a few are assumed to contact the coastline during the 34-year lease life. Small spills would have similar hazards of inhalation, toxic contact, ingestion, and food source contamination. They are, however, more avoidable by adult turtles and less likely to contact turtle habitat than large spills. Conversely, their greater frequency of occurrence may result in greater contributions to the sargassum mat habitat utilized by juveniles. Based on the number of strandings caused by plastic ingestion and collisions, the high mortality of turtle eggs and immature turtles contacting or ingesting oil, and the high probability of such a contact occurring, the resultant population decline would last 2-3 generations.

Conclusion

The cumulative impact on marine turtles is high.

High Case Analysis

The High Case is an optimistic estimate of production and development of the proposed action. The barrels produced, shuttle tanker traffic, the number of platforms and the miles of offshore pipeline in the High Case are approximately twice that of the Base Case (Tables IV-1 and IV-2). The increase in activities and production is accompanied by a greater risk of impacting marine turtles. Collision and oil spillage are anticipated to have the greatest impacts. Increases in shuttle and support traffic will remain a negligible portion of the total traffic in the Gulf of Mexico. The volume and frequency of oil spillage is expected to double based on the doubling of production. This would mean a less than 0.5% probability of a large spill contacting the CPA nesting beaches and a 6% probability of contacting the Louisiana inshore areas frequented by turtles (Table IV-7). A few spills of > 1 and ≤ 50 bbls are likely to occur each year, a low percentage of which will occur in proximity to the coast. During the 34-year lease life, a few will contact the coast. Spills of > 50 and < 1,000 bbls will occur more infrequently at a rate of a few per lease life with only one contacting the coastline during that period. Small spills cause similar impacts but would be more avoidable by adult turtles. Due to the chronic nature of small spills, they may, however, have a greater contact with juveniles inhabiting sargassum mats. Losses resulting from such spillage are likely to have an impact on less than 1% of the population for less than one generation. The doubling of the frequency and volume over the Base Case is not expected to produce impacts greater than for the Base Case. Based on the absence of new onshore construction, the minor contribution of OCS shuttle and tanker traffic, the avoidance of oil by adult turtles, and the low probability of a contact occurring, any resultant population decline will be less than one generation.

Conclusion

The impact of the High Case is estimated to be low.

(c) Whales

Base Case Analysis

Whales are infrequently sighted in the CPA (Fritts et al., 1983). The major whale habitat in the Gulf is in the deep water off the continental shelf. The endangered sperm whale is probably the most numerous whale species in this region and can be found most frequently in the Gulf during June through March along the 1,000-m contour (average of 1,167 m). Pods range from 2 to 14 individuals of mixed sexes and ages, and are usually associated with physical oceanographic features such as the Loop Current (Fritts et al., 1983; Table III-1). All of the OCS oil/gas activities occur on the shelf; however, as exploration and development increase in deepwater areas, there is an increasing probability of adversely impacting endangered whale species in the CPA. The activities and events affecting whales are similar to those described for marine mammals (Section IV.D.2.a.(6)). The significant impact producing factors that could potentially affect whales are Federal OCS-related oil spills, collision with offshore support vessels, use of explosives for the removal of offshore structures, underwater sound emissions, and entanglement/ingestion of offshore oil/gas-related plastic debris.

The most likely effects of oil on cetaceans are skin and eye irritation, baleen fouling, asphyxiation from inhalation of volatile fumes, food reduction or contamination, and oil ingestion (Geraci and St. Aubin, 1982; Goodale et al., 1981; Gruber, 1981). Cutaneous irritation and baleen fouling appear to be short lived when whales return to unoiled water. Asphyxiation by inhalation of noxious fumes is unlikely due to the rapid vaporization and dilution of such fumes; however, several whales off Iran died of respiratory stress, induced by oil inhalation (USDI, MMS 1987c). Surface skimming baleen whales are most vulnerable to oil ingestion due to their feeding behavior, however Geraci and St. Aubin (1982) reported that grey whales appeared to avoid spilled oil by spending less time on the surface and blowing less frequently. Contamination of food sources and its effect on whales is not well documented but is presumed to be localized and short term due to the nature of oil spillage.

Based on the OSRA model, it is likely that if a large spill occurs it will contact one or more whales during the life of the lease. It is assumed that a spill of > 1 and ≤ 50 bbls is likely to occur each year. A low percentage will occur in proximity to coastal resources and one will contact the coast during the lease life. It is assumed that a spill of > 50 and < 1,000 bbls will occur during the lease life but none will contact the coast. Oil spills occurring as a result of the proposed action are unlikely to result in mortality because of the low potential for a whale contacting a spill and because of the transitory effects of oil on cetaceans.

There is also potential for indirect impacts on cetaceans through the impact of oil spills on their food sources (NAS, 1985) and through the impact of oil and other contaminants on their habitat (Sections IV.B.1.a.(2) and (3); Gaskin, 1982). The magnitude of such impacts has not been quantified, but it is expected that effects are sublethal.

Although rare, vessel collisions with whales have been reported by Slijper (1979) and Kraus (1987, personal communication). None have occurred in the Gulf of Mexico and observations of vessel avoidance have been documented off the California coast (BBN Laboratories, Inc., 1986). The absence of reported collisions in the Gulf and the minor contribution that the proposed action will add to the total maritime traffic suggest that collisions would have a very low impact on whales.

As a result of the proposed action, about 30 structures will be installed in the CPA (Table IV-2). In about 15-25 years these structures may be removed. Subsurface explosions have elicited a short-term avoidance reaction in migrating grey whales several miles away, but the NMFS has concluded that an endangered whale would probably need to be very close to the detonation to be killed. Such proximity is unlikely because of avoidance of structures and structure location being inshore of whale habitat. The greatest hazard of substance explosions appears to be sublethal stress and physical impairment to hearing.

Underwater sounds from seismic activities and well drilling apparently do not cause immediate harm to whales (Malme et al., 1984; Gales, 1982) (Section IV.A.3.g.). There is concern that subsurface sound may induce stress and have a cumulative effect on hearing or disrupt acoustic communication among whales. Acoustic disturbance is unlikely to be lethal or alter distribution because of the absence of OCS activities seaward of the continental shelf.

Whales can become entangled in plastic rope, netting, cargo straps, etc., and may ingest plastic/styrofoam materials that may cause injury or death (Laist, 1987). Although entanglement has been reported in the Atlantic and Pacific, none has been directly attributable to oil and gas extraction debris; no sale-related entanglement is expected. Plastic debris disposal at sea is prohibited by MMS regulations and Public Law (MARPOL, Annex V). Based on the absence of collisions, entanglement or contact with structures, and the minor effect of noise and short-term oil contact, the resultant population decline will last less than one generation.

Conclusion

The proposed action is estimated to have a very low impact on whales in the Central Gulf.

Cumulative Analysis

The past, future, and proposed State and Federal offshore oil and gas activities, oil imports, ocean dumping, maritime commerce, and destructive natural events may produce cumulative impacts on whales. The activities and their impacts are similar to those discussed for other marine mammals (Section IV.D.2.a.(6)). Activities that have localized impacts near oil and gas structures are unlikely to have much effect on whales because of their preference for deep water along the continental slope and beyond the continental shelf. Sublethal stress from avoidance of traffic, geophysical surveys and collisions will increase as maritime commerce and research increase. The absence of stress- or collision-related strandings suggest that these impacts are low.

Entanglement, primarily in fishing gear, is an issue of growing concern. Although there have not been reports in the Gulf, it is possible that whales could be entangled in cargo netting, longlines, or drift nets. The Center for Environmental Education (1988) reported that a pygmy sperm whale and minke whale were found stranded on the Texas coast, apparently from the ingestion of plastic. This verifies the hazard of ingestion but leaves the magnitude of the problem in question.

The effects of contacting, inhaling, or ingesting (either directly or through contaminated food) oil could have cumulative impacts on whales. Although the current rate of spillage appears avoidable by whales and the effects are generally sublethal, increased production (particularly in areas frequented by whales) may cause significant stress, illness, or mortality. There is a 99+% probability of one or more large oil spills occurring in the Central Gulf from past, present, and future platform, pipeline, shuttle tanker, and import tanker sources. This suggests that if a large spill occurs it will contact one or more whales during the lease life. Gulfwide there will be approximately 10 large spills from OCS activities and over 33 spills from imported oil during the production life (Table IV-5). It is also assumed that a moderate number of spills (> 1 and ≤ 50 bbls) will occur each year during the production life; most will remain offshore while a few will be proximal to and contact the coast. Spills > 50 and < 1,000 bbls will occur more infrequently--at a rate of a few each year--with only a few contacting the coast during the 34 year lease life. The impacts of large and small spills are similar. Although smaller spills are more avoidable because of their size, they may produce more chronic, long-term effects because of their frequency.

The major whale habitat in the Gulf of Mexico is on the continental slope and in deepwater areas off the continental shelf. Whale habitat in the Central Gulf and the potential impacts thereon are discussed in Sections IV.D.2.a.(2), (3), and (8). As oil/gas exploration and development occurs in deepwater areas, there will be a slight increase in the potential impacts to whales and in the potential indirect impacts to their food sources and habitat. Based on the infrequency of strandings caused by collision, plastic ingestion, oil spillage, and entanglement, a populaton decline of less than one generation will occur.

Conclusion

The cumulative impact of activities in the Central Gulf is estimated to be low.

High Case Analysis

As described in previous sections, the High Case is an optimistic estimate of development and production for the proposed action. It is approximately twice the production, offshore pipelines, and structures as the Base Case. The impacts on whales will remain about the same as the Base Case despite the increase in activities and production. The increase in shuttle and support traffic will be negligible relative to the total maritime commerce of the Gulf. Impacts localized near structures, (i.e., formation discharges, operational noises, and explosive removals) are unlikely to impact whales because of their preferred deepwater habitat beyond the continental slope. Large oil spills will occur with a 37% probability in the High Case (Table IV-5). A few spills of > 1 and ≤ 50 bbls will occur each year, only a few of which will contact the coastline in the life of the lease. Spills of > 50 and < 1,000 bbls will occur more infrequently--at a rate of a few during the lease life--with only one likely to contact the coastline in that period. The impacts of large and small spills are similar; however, small spills are assumed to be more avoidable because of their size, but make a greater contribution to chronic, long-term toxicity because of their higher rate of spillage. Based on the absence of whales stranded by collisions, contact with oil spills or platform discharges, and the likelihood that most impact producing factors are in areas not frequented by whales, a population decline of less than 1% could occur, lasting less than one generation.

Conclusion

The level of impact under the High Case is estimated to be low.

(6) Impacts on Marine Mammals

Nonendangered marine mammals are protected under the Marine Mammal Protection Act of 1972 and are discussed in this marine mammal section. Endangered marine mammals (most large whale species, manatees, etc.) are protected under the Endangered Species Act of 1973 and are discussed in Section IV.D.2.a.(5)(c). The bottlenose dolphin is the most common nonendangered marine mammal that occurs in the Gulf of Mexico (Fritts et al., 1983), and it is the subject of most nonendangered marine mammal research. Therefore, the bottlenose dolphin is used as the primary subject for this marine mammal discussion.

Base Case Analysis

Normal activities and accidental effects associated with OCS oil and gas extraction have direct and indirect impacts on marine mammals. These impacts are described in detail by MMS (USDI, MMS, 1988c), Geraci and St. Aubin (1988), National Research Council (1985) and Boesch and Rabalais (1987). Impacts associated with normal activities include stress induced by construction/operation noise, disturbance by traffic, noxious discharges, and concussion caused by explosives. Reaction to noise varies with species and type of sound. Most species are likely to habituate or show minimal reaction to seismic operations, shuttle and support traffic, and construction/operation activities because of their low intensity and frequency of occurrence. Impacts, if any, are estimated to be minor, short-term and localized based on observations of marine mammals off the California coast (USDI, MMS, 1987c). Disturbances associated with explosive structure removal would be localized but have a greater potential for inducing stress, injury, or death. The MMS explosive removal criteria limit the types and amounts of explosives, the spacing of explosions, and require the use of detraction techniques in an attempt to minimize serious injury. The MMS observers at 17 offshore oil/gas structure removals sighted small (2-5) pods of bottlenose dolphins (no whales) at five sites; no injuries to the dolphins were observed following the explosive severing of the structure.

Reports by the National Academy of Science (1985) suggest that drilling mud and formation discharges do not have a significant impact on marine mammals because they have limited interaction with biota and quickly dilute to background levels.

Accidental events that impact marine mammals include oil spills, vessel collisions, and entanglement/ingestion of marine debris. Species that feed or rest on the surface are most vulnerable to collisions with vessels. The OCS shuttle and support traffic are a negligible contribution to the total traffic in the Gulf of Mexico. The relatively small volume of traffic and the absence of reported accidents in the Gulf suggest that collisions are unlikely to occur. A rare accident will most likely result in the loss of no more than one individual to the population. Entanglement in or ingestion of marine debris can result in impaired mobility and blocked digestion, resulting in a loss of condition and death. Death by ingestion or entanglement appears to be a minor impact on marine mammal populations based on the small number of stranded mammals documented as having died of debris ingestion (Laist, 1987). Entanglement ingestion will have an impact on individuals but is unlikely to impact a population.

Oil spills affect marine mammals by skin and eye irritation, respiratory blockage or inhalation of noxious vapors, ingestion, and contamination of food. Based on the OSRA model, it is likely that if a large oil spill occurs it will contact one or more marine mammals during the life of the sale. The probability of contact and degree of impact are dependent on the species, composition of the oil, meteorological conditions, and the affect on their prey (Geraci and St. Aubin, 1988; Geraci and St. Aubin, 1982; Goodale et al., 1981; Gruber, 1981). Geraci and St. Aubin (1988) summarized the risk of oil on marine mammals by stating that the host of variables makes determination of vulnerability difficult; however, species with large ranges and mobility that feed in the water column verses the surface or bottom are less vulnerable to oil. Baleen whales are the most vulnerable, followed by bottlenose dolphins inhabiting the continental shelf and beyond. Also vulnerable are other toothed whales and dolphins, which are wide ranging. Although bottlenose dolphin habitat appears to make it more vulnerable to contact with spillage, a study suggests that they are able to detect and avoid oil (Geraci and St. Aubin, 1982). The ability to detect and avoid oil spills appears to vary with species. Skin and eye irritation and respiratory disorders caused by contacting oil appears minor and short-term (USDI, MMS, 1987c). Death or illness caused by oil ingestion and by consumption of contaminated food do not appear likely due to the volume of oil needed to cause a disorder; however, long-term impacts, which could shorten life expectancy or reduce fecundity, have not been studied. There is a 21% probability of one or more large spills occurring in the Central Gulf from OCS platform, pipeline, and shuttle tanker activities during the production life. There is also a 99% probability that over 33 spills will occur somewhere in the Gulf during the lease life as a result of tanker-imported oil. It is assumed that one spill of > 1 and ≤ 50 bbls will occur each year, with a few contacting the coastline during the 34-year lease life. Spills of > 50 and < 1,000 bbls will occur less frequently--at a rate of one during the life of the lease; and none contacting the coast. Large and small spills will have similar impacts; however, small spills are more avoidable by those species that discern oil, and their chronic frequency makes them a significant contributor to hydrocarbon accumulation in the environment. Based on the minor, localized and short-term nature of most acoustic disturbances, the absence of reported vessel collisions with marine mammals in the Gulf, the avoidance of oil spills by bottlenose dolphins and the great mobility of offshore species, a populaton decline lasting less than one generation is likely to occur.

Conclusion

The impact on marine mammals as a result of the proposed action is estimated to be low.

Cumulative Analysis

The past, proposed, and future State, and Federal offshore oil and gas activities, ocean dumping, maritime commerce, and destructive natural events may produce cumulative impacts on marine mammals. These activities could cause avoidance of preferred habitats, digestive and respiratory disorders from the ingestion of plastic, collisions, entanglement, explosive concussion, or contact with noxious substances and indirect impacts on food supplies. These impacts are discussed in the Base Case Analysis.

Collisions with vessels are rarely reported and none have been reported in the Gulf of Mexico. They appear to be insignificant because of their infrequency. Entanglement, particularly in fishing gear, has been reported in the Atlantic and Pacific (USDC, NMFS, 1987), but the extent of the impacts in the Gulf is undocumented. Acoustic injury and concussive shock from the use of explosives may increase as a growing number of structures are removed. Potential injury should be mitigated by MMS structure removal guidelines and nonexplosive removal techniques. The stress of traffic and acoustic disturbance is likely to increase as maritime commerce and oil/gas activities expand. Marine mammals appear to habituate to these disturbances and easily avoid collision. Stranding caused by the ingestion of debris is rarely reported, and is thought to be unlikely because of the ability of most nonendangered marine mammals to discern their prey. The marine disposal of radioactive waste, munitions and chemicals could also cause death or illness to individuals. The number of deaths and injuries resulting from the ingestion of debris is unknown, but impacts on the regional population are thought to be low based on the small number of strandings.

There is an 99% probability of a large oil spill occurring in the Central Gulf (Table IV-5) as a result of oil produced in the Gulf of Mexico. There is also a 99+% probability of a spill from imported oil occurring during the production life of the proposed action. It is also assumed that a moderate number of spills (> 1 and ≤ 50 bbls) will occur each year during the production life. Most will remain offshore, but a few will be proximal to and contact the coast each year. Spills of > 50 and < 1,000 bbls will occur more infrequently--at a rate of a few each year--with a few contacting the coastline during the lease life. The impacts of large and small spills on marine mammals are similar. Based on the OSRA model, it is likely that if a large oil spill occurs it will contact one or more marine mammals. Although smaller spills are more avoidable because of their size, they may produce more chronic, long-term effects because of their frequency. This may be particularly true in the contamination of food. Based on minor, short-term and localized effects of acoustic and traffic disturbance; the absence of reported collisions; the limited number of reported deaths or injuries from ingestion/entanglement; explosive concussion; the minor, short-term localized effects of oil inhalation and contact; and the undocumented, long-term effects of ingestion and food source contamination, a population decline lasting less than one generation is likely to occur.

Conclusion

The cumulative impact to marine mammals in the Central Gulf is estimated to be low.

High Case Analysis

As described in Section IV.A.1., the High Case is an optimistic estimate of development and production for the proposed action, which is approximately twice the production, offshore pipelines, and structures as the Base Case. The impacts on marine mammals are expected to remain about the same as the Base Case. Increases in shuttle and support traffic will be negligible relative to the total Gulf of Mexico traffic. Acoustic disturbances including explosive removals will have localized, sublethal impacts on individuals but are unlikely to affect the population. There is a 37% probability that a large oil spill (1,000 bbls or greater) will occur as a result of the High Case (Table IV-5). A few spills of > 1 and ≤ 50 bbls will occur each year, only a few of which will contact the coastline in the life of the lease. Spills of > 50 and < 1,000 bbls will occur more infrequently--at a rate of a few during the lease life--with only one likely to contact the coastline in that period. It is assumed that small spills are more easily avoided by species that can detect spillage (i.e., bottlenose dolphin), but the chronic occurrence of small spills is more likely to result in a greater frequency of contact by undiscerning species. Chronic spillage will also maintain a higher background level of hydrocarbons in the environment.

Conclusion

Based on the minimal contribution of OCS support and tanker traffic to total maritime traffic, the temporary effects of most acoustic disturbances and the avoidance of spills by the most vulnerable species, the impact on marine mammals under the High Case is estimated to be low.

(7) Impacts on Birds Associated with the Coastal Area

The impact producing factors that could potentially affect birds associated with the coastal area as a result of the proposed action include sale-related oil spills, disturbance of birds from feeding and nesting areas due to helicopter and vessel traffic, displacement from onshore pipeline landfalls and facility construction near coastal nesting areas, and entanglement/ingestion of offshore oil/gas-related plastic debris.

Oil spills can be divided into two categories: large spills (1,000 bbls or greater) and small spills (less than 1,000 bbls). Small spills can be further divided into chronic small spills (> 1 and ≤ 50 bbls) and small spills (> 50 and < 1,000 bbls) (Section IV.B.2.). Chronic oil spills may have more long-term harmful consequences than isolated large spills which are the most conspicuous and receive the greatest attention (NAS, 1985). Table S-4 lists the definitions for the five levels of impacts used in the analyses and conclusions.

When an oil spill occurs, many factors determine whether that spill will cause heavy, long-lasting biological damage; comparative little or no damage; or some intermediate degree of damage. Determining factors include geographic location, oil type, oil dosage, impact area, oceanographic conditions, meteorological conditions, and season (USDI, MMS, 1987b; NAS, 1985).

Season is particularly important in terms of biota that might lie in the path of a large spill or in the vicinity of a chronic oiling situation. For example, if a large spill occurs in a seabird feeding, rafting, or nesting habitat (Section III.B.5.), bird mortality would likely be high in that area. During another time of year at that same location, the mortality might be much lower.

Oil type, such as diesel and jet fuel, can have an immediate high impact due to their severe toxicity upon minimal contact. However, these types of oil dissipate rapidly, whereas heavy crudes and Bunker oils are not as highly toxic or volatile, but may cause heavy oiling of biota and remain in the environment for a longer time (NAS, 1985).

The initial and most conspicuous casualties of OCS-related oil spills are externally oiled seabirds that may drift onto shore. Those birds most susceptible to oiling either raft at sea, usually in large numbers, such as gulls, or dive when disturbed, such as cormorants. Because of the strong visual impact, the death of coastal and marine birds from oiling due to an OCS-related spill receives an inordinate amount of publicity (Clapp et al., 1982a; NAS, 1985). Although mortality among marine birds may appear high as the result of a large oil spill, there is no evidence this mortality has adversely affected any species on a population level in the United States' OCS (NAS, 1985).

The direct effect of oiling on a bird is to clog the fine structure of its feathers, which is responsible for maintaining water-repellance and heat insulation (Holmes and Cronshaw, 1977). The decrease in insulation would have greater critical consequences if oiling occurred during the winter in Northern latitudes. Mortality results primarily from hypothermia and shock as oil mats the plumage, destroying a bird's ability to maintain a thermal barrier of trapped air beneath its feathers. The plumage then can absorb water and the bird may sink and drown. Unfortunately, it is unknown to what extent this effect occurs at sea or how many birds are lost in this way. Direct contact by birds with appreciable amounts of oil is usually fatal (NAS, 1985).

Birds ingest oil mainly from preening their oiled plumage. This ingestion causes abnormal conditions in the lungs, adrenals, kidneys, liver, nasal salt glands, and gastrointestinal tract. Deleterious osmoregulation and reproductive hormone changes occur (Holmes, 1984; Peakall et al., 1981). Relatively small amounts of ingested oil can cause a depression of egg laying and can reduce the hatching success of those eggs that are laid (Ainley et al., 1981). Transfer of oil from adults to eggs results in significant mortality for new eggs and deformities in hatchlings from eggs further along in incubation (Clapp et al., 1982a). Stress from ingested oil can be additive to ordinary environmental stresses such as low winter temperatures, migration, or molting (Holmes, 1984). Presumably, the effects of oiling would also be more severe when birds are under environmental or physiological stress.

Major differences in effect may be attributed to differences in the dosage of spilled oil. The impacts from chronic or small spills differ in severity and kind from those of large spills. A large OCS-related spill certainly can be a catastrophic event; however, it will eventually disappear due to physical-chemistry processes and complex degradation (NAS, 1985). On a much smaller scale, chronic or small spills may have the same immediate effect a large spill has on seabirds, but over time, chronic spills may be a more serious problem and will likely become a continuing irritant or sublethal toxicant (NAS, 1985).

Sublethal effects are defined as those that impair the ability of an organism to function effectively without causing direct mortality. Chronic oil spills decrease adult seabird survival and fecundity, modify their normal behavior, and reduce growth rates in young (Clapp et al., 1982a; Szaro et al., 1978). Indirectly, chronic small spills may well contaminate and/or reduce food sources for coastal and marine birds. Consequently, seabirds may be displaced due to lack of food, starve, or expend greater and greater energy to attain a sustaining food quantity. Ingestion of sublethal levels of oil pollutants from contaminated food causes hormonal changes in adult birds, which results in interrupted egg formation, the laying of fewer clutches, and lower clutch sizes (Fry et al., 1987). Sublethal levels of aromatic compounds released from oil may have a narcotic effect on seabirds thus modifying their normal behavior, including their ability to avoid the spilled oil (Nero and Associates, 1983). Duckling growth is impaired and/or abnormal as a result of chronic ingestion of low levels of oil. Liver hypertrophy, splenic atrophy, and kidney damage are a few of the pathological consequences seen from the effects of chronic oil spills on young coastal and marine birds (NAS, 1985; Szaro et al., 1978).

Base Case Analysis

The major impact producing factors analyzed below are sale-related oil spills, helicopter and vessel traffic, pipeline landfalls and coastal facility construction, and oil/gas-related plastic debris.

The majority of coastal and marine bird nesting habitats occur inshore, in coastal bays and marshes, behind barrier islands and beaches. The highest estimated probability of one or more large oil spills (1,000 bbls or greater) occurring and contacting a Central Gulf inshore bay is 2% (Barataria Bay). The estimated mean number of large spills occurring and contacting Barataria Bay is less than 0.05. The highest estimated probability of one or more large spills occurring and contacting western deltaic marshes is 6%. The estimated mean number of large spills occurring and contacting western deltaic marshes is 0.1 (Table IV-7).

The majority of the coastal and marine bird feeding habitats occur nearshore or offshore and could be contacted by OCS-related oil spills. The highest estimated probability of one or more large spills (1,000 bbls or greater) occurring and contacting a Central Gulf coastline is 2% (Plaquemines Parish). The estimated mean number of large spills occurring and contacting Plaquemines Parish is less than 0.05 (Table IV-7).

Small oil spills (less than 1,000 bbls) are subdivided into two size groups: chronic small spills (> 1 and ≤ 50 bbls) and small spills (> 50 and < 1,000 bbls). Section IV.B.2.b. estimates the mean number of small spills (less than 1,000 bbls) occurring from the proposed action. It is assumed that a chronic small spill (> 1 and ≤ 50 bbls) is likely to occur each year during the 34-year lease life. Low percentages of the total chronic small spills are assumed to occur in proximity to coastal resources. A few chronic small spills (> 1 and ≤ 50 bbls) are assumed to contact the coastline during the 34-year lease life. It is assumed that a small spill (> 50 and 1,000 bbls) will occur during the 34-year lease life. However, it is asumed that no small spill (> 50 and < 1,000 bbls) will contact the coastline during the 34-year lease life.

Large oil spills (1,000 bbls or greater) originating "in port" from OCS-related shuttle tankering include those that may occur and contact coastal bays and estuaries. The highest estimated probability of one or more large spills from shuttle tankering occurring and contacting a Central Gulf bay or estuary is 1% (Mississippi River ports). The estimated mean number of large spills from shuttle tankering occurring and contacting a Central Gulf bay or estuary is 0.01 (Section IV.B.1.d.).

It is unlikely that oil spills occurring as a result of the proposed action will interact with coastal and marine bird nesting and feeding habitats in the Central Gulf. Further, this analysis assumes that very little oiling of coastal and marine birds will occur. Therefore, this analysis assumes that no interaction of birds associated with the coastal area and sale-related oil spills will occur.

Disturbance of coastal and marine bird nesting and feeding habitats from pipeline landfalls, onshore construction, and noise associated with helicopter and vessel traffic could result in a reduction or desertion of birds that use the habitats (USDI, MMS, 1985; Wicker and Rabalais, 1988). Dredging and the construction of pipelines and roads could change hydrology, which may result in complete conversion of a marsh ecosystem (Section IV.D.1.a.(1)). However, no new OCS oil/gas-related pipeline landfalls or coastal facilities are projected as a result of the proposed action in the CPA (Table IV-1).

It is estimated that during the peak year of the proposed action 3,671 OCS oil/gas service vessel trips, 21 shuttle tanker trips, and 6,662 helicopter trips will occur (Table IV-1). This represents a negligible amount of the total annual vessel traffic in the Gulf of Mexico. The majority of the OCS oil/gas traffic occurs in/out of existing port areas; therefore, it is likely that this activity, as a result of the proposed action, will have a very low impact on birds associated with the coastal area in the CPA.

Coastal and marine birds can become entangled in monofilament fishing line, netting, 6-pack yokes, etc., which may result in injury or mortality. Ingestion of plastic/styrofoam materials may cause internal blockage, resulting in injury or mortality (Centaur Associates, Inc. and Center for Environmental Education, 1986). Ingested plastic may impair feeding activity where plastic reduces the food storage volume of the stomach and limits the accumulation of fat reserves essential for reproduction and migration (Ryan, 1988). Entanglement/ingestion of OCS oil/gas-related plastic debris by coastal and marine birds is not expected to have an impact as a result of the proposed action. The MMS prohibits the disposal of equipment, containers, and other materials into offshore waters by lessees (30 CFR 250.40). In addition, MARPOL, Annex V, Public Law 100-220 (101 Statute 1458), which prohibits the disposal of any plastics at sea or in coastal waters, is in effect as of January 1, 1989.

Conclusion

A very low level of impact on birds associated with the coastal area and their feeding and nesting habitats is estimated to occur in the Central Gulf as a result of the Base Case.

Cumulative Analysis

This cumulative analysis considers the effects of impact producing factors related to the proposed action plus those related to prior and future OCS sales, State oil and gas activity, crude oil imports by tanker, and other commercial, military, and recreational offshore and coastal activities that may occur and adversely affect birds associated with the coastal area. Specific types of impact producing factors considered in the analysis include oil spills, helicopter and vessel traffic, pipeline landfalls and coastal construction, dredging, fishing gear, plastic debris, and water contamination.

The estimated probability of one or more large oil spills (1,000 bbls or greater), resulting from the proposed action, prior and future OCS leasing, and the tankering of imported oil, occurring and contacting land in the Gulf of Mexico is greater than 99%. The estimated mean number of large spills to occur and contact land in the Gulf is 5.5. Plaquemines Parish, Louisiana, is the land segment with the highest probability (73%) of being contacted by one or more large spills. Barataria Bay is the coastal inshore bay with the highest probability (68%) of being contacted by one or more large spills. The estimated probability of one or more large spills occurring and contacting western deltaic marshes is 96%. The estimated mean number of large spills to occur and contact western deltaic marshes is 3.2 (Table IV-7).

Section IV.B.2.b. estimates the mean number of small spills (less than 1,000 bbls) occurring from the proposed action and other impact producing factors mentioned above. It is assumed that a moderate number of chronic small spills (> 1 and ≤ 50 bbls) would occur each year. A few chronic small spills would occur each year in each OCS analysis area in proximity to coastal environments. A few chronic small spills are assumed to contact the coastline each year. It is assumed that a few small spills (> 50 and < 1,000 bbls) would occur each year. A few small spills are assumed to contact the coastline during the 34-year lease life.

Large oil spills (1,000 bbls or greater) originating "in port" from the tankering of imported oil include those that may occur and contact bays and estuaries. The highest estimated probability of one or more large oil spills from the tankering of imported oil occurring and contacting a Central Gulf bay or estuary is 89% (Louisiana Offshore Oil Port). The estimated mean number of large spills from the tankering of imported oil occurring and contacting a Central Gulf bay or estuary is 2.25 (Section IV.B.1.d.).

Due to the high aggregate probability of oil spills occurring and contacting the Central Gulf coastline and coastal inshore bays and marshes, it is very likely that some oil spills will occur and contact coastal and marine birds and their feeding and nesting habitats in some localized areas. Further, this analysis assumes that oil spills will contact feeding and nesting habitats. Therefore, it is expected that there will be a moderate impact on birds associated with the coastal area in the CPA from oil spills.

Disturbance from helicopter and vessel traffic in the vicinity of bird feeding and nesting habitats in the CPA is unlikely to increase above current levels as a result of OCS-related oil/gas activities from the proposed action. The cumulative service vessel trips are estimated at 26,270, shuttle tankering trips at 184, and helicopter trips at 47,997 (Table IV-1). This represents a negligible amount of the total annual vessel traffic in the Gulf of Mexico. The majority of the OCS-related oil/gas traffic occurs in/out of existing port areas. Cumulative disturbance from helicopter and vessel traffic is likely to have a low impact on coastal and marine birds in localized high traffic areas.

Cumulative impacts will moderately increase as a result of OCS-related onshore construction of about 2 service bases, 2 pipeline landfalls, 50 miles of onshore pipeline, and 1 marine terminal (Table IV-1).

Impacts unrelated to OCS activities include the loss of habitats to commercial, military, recreational, and residential construction. Dredging and draining of wetland areas along migratory flyways, in coastal feeding areas, and in overwintering areas cause additional habitat loss. Entanglement in commercial and recreational fishing gear and plastic debris causes injuries/death of birds. Coastal storms and hurricanes cause flooding and destruction of nesting areas, resulting in coastal and marine bird losses. High levels of oil and organic chemical contamination in the river runoff into the northern Gulf of Mexico could cause direct mortality or indirect food loss to avian species. Collision with power lines and supporting towers causes additional bird mortality (Avery et al., 1980). These impact producing factors, in aggregate, are judged to result in a moderate amount of adverse effects on birds associated with the coastal area by the destruction, alteration, and/or disturbance of feeding and overwintering areas and by injury and mortality of numerous individual coastal and marine birds.

Conclusion

A moderate level of cumulative impact on birds associated with the coastal area and their feeding and nesting habitats is estimated to occur in the Central Gulf as a result of the proposed action, prior and future OCS sales, and other impact producing factors.

High Case Analysis

The major impact producing factors analyzed below are sale-related oil spills, helicopter and vessel traffic, pipeline landfalls and coastal facility construction, and oil/gas-related plastic debris.

Plaquemines Parish, Louisiana, is the land segment with the highest probability (5%) of being contacted by one or more large oil spills (1,000 bbls or greater). The estimated mean number of large spills occurring and contacting Plaquemines Parish is less than 0.05. Barataria Bay is the coastal inshore bay with the highest probability (4%) of being contacted by one or more large oil spills. The estimated mean number of large spills occurring and contacting Barataria Bay is less then 0.05. The highest probability of one or more large spills occurring and contacting western deltaic marshes is 11%. The estimated mean number of large spills occurring and contacting western deltaic marshes is 0.1 (Table IV-7).

Small oil spills (less than 1,000 bbls) are subdivided into two size groups: chronic small spills (> 1 and ≤ 50 bbls) and small spills (> 50 and $< 1,000$ bbls). Section IV.B.2.b. estimates the mean number of small spills (less than 1,000 bbls) occurring from the proposed action. It is assumed that a chronic small spill (> 1 and ≤ 50 bbls) is likely to occur each year during the 34-year lease life. Low percentages of the total chronic small spills are assumed to occur in proximity to coastal resources. A few chronic small spills (> 1 and ≤ 50 bbls) are assumed to contact the coastline during the 34-year lease life. It is assumed that a few small spills (> 50 and 1,000 bbls) will occur during the 34-year lease life. It is asumed that a small spill (> 50 and $< 1,000$ bbls) will contact the coastline during the 34-year lease life.

Large oil spills (1,000 bbls or greater) originating "in port" from OCS-related shuttle tankering may include those that occur and contact bays and estuaries. The highest estimated probability of one or more large oil spills from shuttle tankering occurring and contacting a Central Gulf bay or estuary is 3% (Mississippi River ports). The estimated mean number of large spills from shuttle tankering occurring and contacting a Central Gulf bay or estuary is 0.03 (Section IV.B.1.d.).

It is unlikely that oil spills occurring as a result of the proposed action will interact to an appreciable extent with coastal and marine bird nesting and feeding habitats in the Central Gulf. Further, this analysis assumes that very little oiling of coastal and marine birds will occur. Therefore, this anaysis assumes that no interaction of birds associated with the coastal area and sale-related oil spills will occur.

Disturbance of coastal and marine bird nesting and feeding habitats from pipeline landfalls, onshore construction, and noise associated with helicopters and OCS oil/gas service vessel and shuttle tanker traffic could result in a reduction or elimination of birds that use the habitats (USDI, MMS, 1985; Wicker and Rabalais, 1988). Dredging and the construction of pipelines and roads could change hydrology, which may result in complete conversion of the marsh ecosystem. However, no new OCS oil/gas-related pipeline or onshore construction, which may affect coastal and marine bird habitats, is projected as a result of the proposed action in the CPA (Table IV-1).

It is estimated that during the peak year of this proposed action 4,992 OCS oil/gas service vessel trips, 41 shuttle tanker trips, and 4,992 helicopter trips will occur (Table IV-1). This represents a negligible amount of the total annual vessel traffic in the Gulf of Mexico. The majority of the OCS-related oil/gas traffic occurs in/out of existing port areas; therefore, it is likely that this activity, as a result of the proposed action, will have a very low impact on birds associated with the coastal area in the CPA.

It is estimated that entanglement/ingestion of plastic debris from offshore oil/gas-related activities is unlikely to have an impact on coastal and marine birds in the CPA as a result of the proposed action.

Conclusion

A very low level of impact on birds associated with the coastal area and their feeding and nesting habitats is estimated to occur in the Central Gulf as a result of the High Case.

(8) Impacts on the Commercial Fishing Industry

The major impact producing factors on fishing activities from the proposed action would be construction of production platforms, OCS-produced water discharge, sale-related oil spills, and underwater OCS obstructions such as pipelines and debris. One production platform, with a surrounding 500-ft navigational safety zone, may remove approximately 9 acres of trawling space, and underwater OCS obstructions cause gear conflicts that result in such losses as trawls, shrimp catch, business downtime, and vessel damage. The financial losses from gear conflicts are covered by the Fishermen's Contingency Fund (FCF). All of the 230 claims (averaging about $4,000) submitted for payment for damages on the OCS Gulfwide before November 1, 1982, when the new regulations were published, have been settled. In 1983, 117 claims (averaging about $3,300) were filed and processed with 73% being approved. During FY 84, 183 claims were processed with 61% being approved for a total of $418,000. During FY 85, 119 claims were processed with 76% being approved for a total of $561,199. During FY 86, 174 claims were processed with 80% being approved for a total of $875,245. During FY 87, 127 claims were processed with 85% being approved for a total of $612,993. The average claim processing time has been reduced from as much as 7 months to about 50 days after NMFS receives the completed claim. Although this fund is effective, fishermen filing claims, as well as those that do not bother to do this, are absorbing some economic loss from this impact producing factor.

Recently, in light of the projected number of structure removals, the Louisiana Concerned Shrimpers Association has brought to the attention of MMS its concern over debris remaining on the site after structures are removed. Subpart C of 30 CFR 250.112(i) requires that the well locations be cleared of all obstructions. In addition, NTL 81-5 establishes the minimum requirement for verification of site clearance. In order to minimize debris impacts on commercial fishing, MMS is currently working with the shrimpers and the Fisheries Advisory Subcommittee of the Offshore Operators Committee (OOC) to (a) determine the types and amounts of materials that are being cleared from the site of structure removals and (b) determine if claims being made to the FCF are more closely associated with any type of OCS activity such as structure removal, wellhead completion, or structure emplacement. In addition, MMS is working with the OOC to further identify acceptable techniques to accomplish the requirements of the CFR mentioned above.

Oil spills can be divided into two categories: large spills (1,000 bbls or greater) and small spills (less than 1,000 bbls). Small spills can be further divided into chronic small spills (less than 50 bbls) and small spills (greater than 50 bbls) (Section IV.B.2.b.). Chronic oil spills may have more long-term harmful consequences than isolated large spills, which are the most conspicuous and receive the greatest attention (NAS, 1985).

When an oil spill occurs, many factors determine whether that spill will cause heavy, long-lasting biological damage; comparative little or no damage; or some intermediate degree of damage. Determining factors include geographic location, oil type, oil dosage, impact area, oceanographic conditions, meteorological conditions, and season (USDI, MMS, 1987b; NAS, 1985).

Season is particularly important in terms of biota that might lie in the path of a large spill or in the vicinity of a chronic oiling situation. For example, if a large spill occurs in a major spawning area of a commercial fish species (Section III.B.6.), fish mortality would likely be high in that area. During another time of year at that same location, the mortality might be much lower.

Oil type, such as diesel and jet fuel, can have an immediate high impact due to their severe toxicity upon minimal contact. However, these types of oil dissipate rapidly, whereas heavy crudes and Bunker oils are not as highly toxic or volatile, but may cause heavy oiling of biota and remain in the environment for a longer time (NAS, 1985).

The direct effects of spilled oil on fish occurs through the ingestion of oil or oiled prey and the uptake of dissolved petroleum products through the gills and epithelium by adults and juveniles or through mortality of eggs and decreased survival of larvae. Although adult finfish may actively avoid an oil spill, all floating eggs and larvae, with their limited mobility, and most juveniles would likely be destroyed when contacted by spilled oil. Some stages of eggs and most stages of larvae are more vulnerable to oil than are juveniles and adults (NAS, 1985). The ingestion or uptake of oil by an adult fish causes abnormal conditions in the gills, liver, gastrointestinal tract, vertebrae, brain, and olfactory organs. Consequently, deleterious reproductive and physiological changes occur. Exposure to spilled oil is usually immediately lethal to fish eggs, but exposure can also arrest hatching or cause larval deformities by effecting embryonic development before hatching. Larval fish respond to spilled oil with a brief increase in activity, followed by reduced activity, sporadic twitching, narcosis, and ultimately death (Linden et al., 1979; Longwell, 1977; NAS, 1985). Ordinary environmental stresses may predispose fish to increased sensitivity to oil toxicity. These stresses may include changes in salinity, temperature, and food abundance (Evans and Rice, 1974; NAS, 1985).

Oil spills that contact bays, estuaries, and waters of the OCS, during the time when high concentrations of pelagic eggs and larvae are present, have the greatest potential for damage to commercial fishery resources. The majority of the Gulf's fishes are estuarine dependent. Potentially, oil spills contacting estuaries could seriously impact Gulf commercial fishery resources such as menhaden, shrimp, and blue crabs that use these areas as nursery and/or spawning grounds. In addition, pollution from chronic oiling in Gulf coastal wetlands effects all life stages of a sessile fishery resource such as oysters (Section IV.D.1.a.(3)).

Major differences in effect may be attributed to differences in the dosage of spilled oil. The impacts from chronic or small spills differ in severity and kind from those of large spills. A large OCS-related spill certainly can be a catastrophic event; however, it will eventually disappear due to physical-chemistry processes and complex degradation (NAS, 1985). On a much smaller scale, chronic or small spills may have the same immediate effect a large spill has on commercial fish resources, but over time, chronic spills may be a more serious problem and will likely become a continuing irritant or sublethal toxicant (NAS, 1985).

Sublethal effects are defined as those that impair the ability of an organism to function effectively without causing direct mortality. Chronic oil spills effect adult and juvenile fish by decreasing their resistance to disease and ordinary environmental stresses, by decreasing reproductive potential, by modifying their normal behavior, and by reducing growth rates (Linden et al., 1979). Sublethal levels of aromatic compounds released from oil may have a narcotic effect on adult and juvenile fish, thus modifying their normal behavior, such as prey location, predator avoidance, mate location, homing behavior, and their ability to avoid the spilled oil (Evans and Rice, 1974; NAS, 1985).

Fish have the capability to metabolize hydrocarbons from spilled oil and can excrete both metabolites and parent compounds from the gills and liver. There is some evidence that metabolites can persist in the tissues longer than parent hydrocarbons, but their toxicity is unknown (NAS, 1985). For OCS-related oil spills to have a significant impact on a commercial fishery resource, a large number of eggs would have to be concentrated in the immediate spill area. Oil components also would have to be present in highly toxic concentrations during the time when both eggs and larvae were in the pelagic stage (Longwell, 1977). There is no evidence to date that commercially important Gulf fish stocks have been significantly affected by spills or chronic oiling. The effects may be masked by natural fluctuations in populations and our present, crude stock assessment methods (NAS, 1985).

Commercial fishery resources could also be adversely affected by the discharge of drilling muds and produced waters. Drilling muds contain materials toxic to marine fishes; however, this is only at concentrations four or five orders of magnitude higher than those found more than a few meters from the discharge point (NAS, 1983). Further dilution is extremely rapid in offshore waters to the extent that every substance measured in the water column is at background levels at a distance of 2,000 m (probably within 1,000 m) of the discharge point (Ecomar, Inc., 1980). Drilling muds are discussed in greater detail in Section IV.A.3.a. In addition to toxic trace elements and hydrocarbons in produced waters, there are additional components and properties, such as hypersalinity and hypoxia, that have a potential to adversley affect commrecial fishery resources. Produced waters that are discharged offshore are diluted and dispersed rapidly to the extent that potential adverse effects to marine fisheries are undetectable at a distance of 100 m from the discharge point and may be limited to within a few meters of the source (Harper, 1986; Middleditch, 1981). Discharge of produced waters into inshore and coastal waters appears to have a greater potential to adversely affect the ecosystem than discharges offshore (Boesch et al., 1988). Produced waters discharged into bays and estuaries may impact commercial fishery resources. Effects of hypersalinity and hypoxia are not significant and negligible when compared to the effects of trace element and hydrocarbon contamination (Boesch et al., 1988). Decreases or elimination of food sources by the discharge of produced waters into fishery nursery areas could potentially impact juveniles of Gulf finfish resources such as menhaden, croaker, mullet, and drum. Direct ingestion of, or long-term exposure to, contaminated sediments could have a lethal/sublethal effect on shrimp and blue crabs. Oysters, located proximate to inshore discharge sites, bioaccumulate hydrocarbons from produced waters (Boesch et al., 1988). This accumulation could potentially render the oysters unmarketable in the short-term and will likely cause sublethal effects to all oyster life stages, proximate to the discharge site, in the long-term. The aerial extent of sediment contamination and potential adverse effects from produced waters may extend from 50 m to 1 km from the discharge points (Boesch et al., 1988). Coastal facilities that separate produced waters from product streams originating in the OCS and discharge the produced waters into fishery nursery areas are located exclusively in the CPA (Louisiana) and are relatively few in number (Boesch et al., 1988). Produced waters are discussed in greater detail in Section IV.A.3.a.

The emplacement/construction of pipelines, pipeline canals, navigation channels, and landside support facilities may contribute to changes in salinity regimes, water current patterns, turbidity, and/or wetland/seagrass loss, which in turn will have a negative impact on fishery resources (USDI, MMS, 1985; Wicker and Rabalais, 1988).

The removal of structures by explosives has caused mortality to a commercial fishery species. Fish kills comprised predominantly of red snapper have been observed after explosives were used to remove structures in the Gulf of Mexico. The magnitude of this problem has not been studied. However, if structure removal by explosives is continued, it could potentially impact the commercial fishing industry proximate to the removal site. However, in view of the positive influence the presence of offshore platforms, acting as artificial reefs and Fish Attracting Devices, has on Gulf of Mexico commercial fishing (Section III.B.6.), continued structure removal, regardless of the technique used, will decrease the positive influence of platform presence. Refer to the *Programmatic Environmental Assessment: Structure Removal Activities, Central and Western Gulf of Mexico Planning Areas* and to *Rigs-to-Reefs: The Use of Obsolete Petroleum Structures as Artificial Reefs* for a further discussion of impacts (USDI, MMS, 1987a and d).

Table S-4 lists the definitions for the five levels of impacts used in the analyses and conclusions. The following criteria were used in the analysis of major impacts on the commercial fishing industry:

- The loss of fishing area from platform/structure construction will result in a very low impact if the number of acres lost represents less than 0.1% of the trawling area. The trawling area includes Federal waters (planning areas) extending offshore to approximately the 400-m isobath.

- It is not possible to determine the number of platforms that will be constructed in State waters; consequently, this factor is not included in the cumulative impact analysis.

- Large oil spills (1,000 bbls or greater) from OCS-related activity contacting State inshore nursery areas within 10 days of a spill will result in moderate, short-term (less than 1 year in duration) consequences on vertebrate fisheries and moderate, medium-term (1-2 years in duration) consequences on invertebrate fisheries, and will deter fishing in these areas.

- Small oil spills (less than 1,000 bbls) from OCS-related activity contacting State inshore nursery areas within 10 days of a spill will result in localized, moderate short-term (less than 1 year in duration) consequences on fisheries resources. Cumulatively over the long-term, chronic small spills may impact these resources; however, there is presently no evidence that small spills have had any more than minimal cumulative impacts on fisheries resources over the long history of oil and gas development and production in the Gulf.

Base Case Analysis

The major impact producing factors analyzed below are sale-related production platform emplacement, produced water discharge and oil spills. In addition to these, other impact producing factors including underwater OCS obstructions, discharge of drilling muds, emplacement of pipelines, dredging canals, and structure removals are discussed above. Gear conflicts caused by underwater OCS obstructions are mitigated by the Fishermen's Contingency Fund. The dredging of canals and the emplacement of pipelines will contribute to fishery habitat loss and, therefore, negatively impact fishery resources. Drilling mud discharges (Table IV-1) contain chemicals that are toxic to marine fishes; however, this is only at concentrations four or five orders of magnitude higher than those found more than a few meters from the discharge point. Structure removal results in habitat loss and causes fish kills when explosives are used. In conclusion, although these other impact producing factors can negatively influence commercial fishery industries, with regard to the proposed action, they contribute a very negligible effect.

Twenty-five offshore platforms/structures (Table IV-1) are expected to result from the proposed action, eliminating less than 0.1% (900 acres) of the trawling area in the CPA. This loss of trawling area would result in a very low impact.

The amount of OCS-produced water projected to be discharged into Louisiana coastal waters during the 34-year lease life is 44,319 bbls/day. This amount is based on the determination that 38% of the total amount of OCS-produced waters (Table IV-1) projected for this proposed action will be piped ashore (Boesch et al., 1988). Potential adverse efffects from this discharge occur in localized areas extending up to 1 km from the discharge point. Therefore, this analysis assumes that OCS-produced water discharge will adversely affect fishery nursery habitats and that a high level of impact will result within and proximate to a few localized inshore areas in the CPA. However, the impact from OCS-produced water discharge on the commercial fishing industry is estimated to be very low.

Table IV-7 identifies the projected risk of one or more large oil spills (1,000 bbls or greater) occurring and contacting the coastal bays and marshes critical to the well being of the commercial fishing industries in the CPA. The highest risk of one or more large oil spills occurring and contacting a coastal bay in the Central Gulf is 2% (Barataria Bay). The estimated mean number of large spills occurring and contacting Barataria Bay is less than 0.05. The highest estimated probability of one or more large spills occurring and contacting western deltaic marshes is 6%. The estimated mean number of large spills occurring and contacting western deltaic marshes is 0.1 (Table IV-7).

Small oil spills (less than 1,000 bbls) are subdivided into two size groups: chronic small spills (> 1 and ≤ 50 bbls) and small spills (> 50 and < 1,000 bbls). Section IV.B.2.b. estimates the mean number of small spills (less than 1,000 bbls) occurring from the proposed action. It is assumed that a chronic small spill (> 1 and ≤ 50 bbls) is likely to occur each year during the 34-year lease life. Low percentages of the total chronic small spills are assumed to occur in proximity to coastal resources. A few chronic small spills (> 1 and ≤ 50 bbls) are assumed to contact the coastline during the 34-year lease life. It is assumed that a small spill (> 50 and 1,000 bbls) will occur during the 34-year lease life. However, it is asumed that no small spill (> 50 and < 1,000 bbls) will contact the coastline during the 34-year lease life.

Large oil spills (1,000 bbls or greater) originating "in port" from OCS-related shuttle tankering include those that may occur and contact coastal bays and estuaries. The highest estimated probability of one or more large spills from shuttle tankering occurring and contacting a Central Gulf bay or estuary is 1% (Mississippi River ports). The estimated mean number of large spills from shuttle tankering occurring and contacting a Central Gulf bay or estuary is 0.01 (Section IV.B.1.d.).

It is unlikely that oil spills occurring as a result of the proposed action will interact with commercial fishery resources in the Central Gulf. Therefore, this analysis assumes that no interaction of commercial fisheries resources and sale-related oil spills will occur and that a very low level of impact will result. As a singular example, the highest estimated probability of one or more large oil spills (1,000 bbls or greater) occurring and contacting Gulf menhaden during their winter spawning in the CPA is 2%. The estimated mean number of large spills occurring and contacting Gulf menhaden at that time and location is less than 0.05 (Table IV-7).

Conclusion

A very low level of impact on the commercial fishing industry is estimated to occur in the Central Gulf as a result of the Base Case.

Cumulative Analysis

This cumulative analysis considers the effects of impact producing factors related to the proposed action plus those related to the Western Gulf proposed action, prior and future OCS sales, State oil and gas activity, crude oil imports by tanker, and offshore recreational fishing that may occur and adversely affect the commercial fishing industry in the same general area that may be affected by OCS oil and gas activity located in the CPA. Specific types of impact producing factors considered in the analysis include oil spills, OCS-produced water dishcarge, offshore oil and gas platforms, commercial fishing techniques/practices, space use conflicts, and wetlands loss.

The 285 additional platforms resulting from the proposed action plus prior and future OCS sales in the CPA (Table IV-1) are estimated to reduce trawling area in the CPA by about 2,565 acres or less than 0.1%. This loss of trawling area should result in a very low impact.

Produced water discharged from OCS-related oil/gas activities is projected to amount to 1.58 million bbls/day (38% of total OCS-produced water). An unknown but expected substantial amount would also be discharged from State oil and gas activities. Therefore, this analysis assumes that OCS-produced water discharge will adversely affect fishery nursery habitats and that a high level of impact will result within and proximate to many localized inshore areas in the CPA. The impact from OCS-produced water discharge on the commercial fishing industry is estimated to be high.

The estimated probability of one or more large oil spills (1,000 bbls or greater) resulting from the proposed action, prior and future OCS leasing, and the tankering of imported oil, occurring and contacting land in the Gulf of Mexico is greater than 99%. The estimated mean number of large spills to occur and contact land in the Gulf is 5.5. Plaquemines Parish, Louisiana, is the land segment with the highest probability (73%) of being contacted by one or more large spills. Barataria Bay is the coastal inshore bay with the highest probability (68%) of being contacted by one or more large spills. The estimated probability of one or more large spills occurring and contacting western deltaic marshes is 96%. The estimated mean number of large spills to occur and contact western deltaic marshes is 3.2 (Table IV-7).

Section IV.B.2.b. estimates the mean number of small spills (less than 1,000 bbls) occurring from the proposed action and other impact producing factors mentioned above. It is assumed that a moderate number of chronic small spills (> 1 and ≤ 50 bbls) would occur each year. A few chronic small spills would occur each year in each OCS analysis area in proximity to coastal environments. A few chronic small spills are assumed to contact the coastline each year. It is assumed that a few small spills (> 50 and < 1,000 bbls) would occur each year. A few small spills are assumed to contact the coastline during the 34-year lease life.

Large oil spills (1,000 bbls or greater) originating "in port" from the tankering of imported oil include those that may occur and contact bays and estuaries. The highest estimated probability of one or more large oil spills from tankering of imported oil occurring and contacting a Central Gulf bay or estuary is 89% (Louisiana Offshore Oil Port). The estimated mean number of large spills from tankering of imported oil occurring and contacting a Central Gulf bay or estuary is 2.25 (Section IV.B.1.d.).

Due to the high aggregate probability of oil spills occurring and contacting the Central Gulf coastline and coastal inshore bays and marshes, it is very likely that some oil spills will contact and interact with commercial fishery resources in their spawning and/or nursery habitats. Therefore, this analysis assumes that oil spills will contact spawning and/or nursery habitats and that a high level of impact will result. The highest estimated probability of one or more large oil spills (1,000 bbls or greater) occurring and contacting Gulf menhaden during their winter spawning in the CPA is 61%. The estimated mean number of large spills occurring and contacting Gulf menhaden at that time and location is 0.9 (Table IV-7).

Commercial fisheries in the Gulf of Mexico are also impacted by activities and events other than the oil and gas industry. Competition between large numbers of commercial fishermen, between commercial operations employing different fishing methods, and between commercial and recreational fishermen for a given fishery resource, as well as natural phenomena such as weather, hypoxia, and red tides, may reduce standing populations. Fishing techniques such as trawling, gill netting, or purse seining, when practiced non-selectively, may reduce the standing stocks of the desired target species as well as significantly impact species other than the target. In addition, the shrimping industry, discarding large numbers of groundfish such as croakers and spot in their by-catch, may be contributing to substantial reductions in the numbers of these commercial species. Space use conflicts can result from different forms of commercial operations and between commercial and recreational fisheries. In the Central Gulf, for example, crab trapping and inshore shrimping operations may occur in the same area, resulting in the loss of fishing area to one or the other or in gear conflicts when both operations attempt to use the same space. Also, wetlands loss is being closely studied to determine in what way and to what extent this loss affects commercial fisheries. Finally, hurricanes may impact commercial fisheries by destroying oyster reefs, damaging gear and shore facilities, and changing physical characteristics of estuaries. With the exception of hurricanes, these impacts are of a short-term nature.

Conclusion

A high level of cumulative impact on the commercial fishing industry is estimated to occur in the Central Gulf as a result of the proposed action, prior and future OCS sales, and other impact producing factors, added to the widely varying baseline conditions resulting from natural environmental factors.

High Case Analysis

The major impact producing factors analyzed below are sale-related production platform emplacement, OCS-produced water discharge, and oil spills. Although, as previously discussed, other impact producing factors can negatively influence commercial fishery industries, with regard to the proposed action, they contribute a very negligible effect.

Fifty offshore platforms/structures (Table IV-1) are expected to result from the proposed action, eliminating less than 0.1% (450 acres) of the trawling area in the CPA. This loss of trawling area would result in a very low impact.

The amount of OCS-produced water projected to be discharged into Louisiana coastal waters is 1.08 billion bbls/day. This amount is based on the determination that 38% of the total amount of OCS-produced waters (Table IV-1) projected for this proposed action will be piped ashore (Boesch et al., 1988). Potential adverse effects from this discharge occur in localized areas extending up to 1 km from the discharge point. Therefore, this analysis assumes that OCS-produced water discharge will adversely affect fishery nursery habitats and that a high level of impact will result within and proximate to a few localized inshore areas in the CPA. However, the impact from OCS-produced water discharge on the commercial fishing industry is estimated to be very low.

Plaquemines Parish, Louisiana, is the land segment with the highest probability (5%) of being contacted by one or more large oil spills (1,000 bbls or greater). The estimated mean number of large spills occurring and contacting Plaquemines Parish is less than 0.05. Barataria Bay is the coastal inshore bay with the highest probability (4%) of being contacted by one or more large oil spills. The estimated mean number of large spills occurring and contacting Barataria Bay is less than 0.05. The highest probability of one or more large spills occurring and contacting western deltaic marshes is 11%. The estimated mean number of large spills occurring and contacting western deltaic marshes is 0.1 (Table IV-7).

Small oil spills (less than 1,000 bbls) are subdivided into two size groups: chronic small spills (> 1 and ≤ 50 bbls) and small spills (> 50 and < 1,000 bbls). Section IV.B.2.b. estimates the mean number of small spills (less than 1,000 bbls) occurring from the proposed action. It is assumed that a chronic small spill (> 1 and ≤ 50 bbls) is likely to occur each year during the 34-year lease life. Low percentages of the total chronic small spills are assumed to occur in proximity to coastal resources. A few chronic small spills (> 1 and ≤ 50 bbls) are assumed to contact the coastline during the 34-year lease life. It is assumed that a few small spills (> 50 and < 1,000 bbls) will occur during the 34-year lease life. It is asumed that a small spill (> 50 and < 1,000 bbls) will contact the coastline during the 34-year lease life.

Large oil spills (1,000 bbls or greater) originating "in port" from OCS-related shuttle tankering may include those that occur and contact bays and estuaries. The highest estimated probability of one or more large oil spills from shuttle tankering occurring and contacting a Central Gulf bay or estuary is 3% (Mississippi River ports). The estimated mean number of large spills from shuttle tankering occurring and contacting a Central Gulf bay or estuary is 0.03 (Section IV.B.1.d.).

It is unlikely that oil spills occurring as a result of the proposed action will interact to an appreciable extent with commercial fishery resources in the Central Gulf. Therefore, this analysis assumes that oil spills will not contact spawning and/or nursery habitats and that a very low impact will result. The highest estimated probability of one or more large oil spills (1,000 bbls or greater) occurring and contacting Gulf menhaden during their winter spawning in the CPA is 3%. The estimated mean number of large spills occurring and contacting Gulf menhaden at that time and location is less than 0.05 (Table IV-7).

Conclusion

A very low level of impact on the commercial fishing industry is estimated to occur in the Central Gulf as a result of the High Case.

(9) Impacts on Recreational Beach Use

Major recreational beaches are defined as those frequently visited sandy areas along the shorefront exposed to the Gulf of Mexico which support a multiplicity of recreational activity, most of which is focused at the land and water interface. Included are National Seashores and Parks, State Park and Recreational Areas, county and local parks, urban beachfronts, private resort areas, and State and private environmental preservation and conservation areas. The general location of these beaches are reflected on Visual No. 3 and a Gulfwide listing of specific major Gulf front beaches are individually identified by county on the back of this visual. The value of recreation and tourism in the Gulf of Mexico coastal zone from Texas through Alabama is approaching $10 billion annually (Section III.C.10.). A significant portion of tourism expenditures are attributed to coastal counties where major shorefront beaches are primary recreational attractions.

The primary impacting factors associated with offshore leasing most widely recognized as major threats to the enjoyment and use of recreational beaches are trash and debris and large oil spills. These are discussed in Sections IV.A.3.h. and IV.B, respectively. Other factors associated with offshore sales, such as pipeline landfalls (removal of rights-of-way across beaches during construction), offshore structure development (aesthetic implications), onshore support facility development (displacement of beach area), and lease site operational activity (noise), can directly and indirectly impact shorefront beaches and associated recreational activities. However, none of these other impacting factors are issues or major threats to the integrity or public use characteristics of major Gulf-front recreational beaches of the CPA or WPA.

Widely publicized and investigated oil spill incidences such as the Santa Barbara spill of 1969, the IXTOC 1 spill in 1979, and the Alvenus tanker spill of 1984 have demonstrated that beaches, and recreational use of beaches, can be severely impacted from large oil spills. Although duplication of IXTOC 1 or Santa Barbara is considered remote in light of current technology and preventative mechanisms in place (Sections I.B.3., 4., and 5), such incidences have occurred and may be conceivable in the future development of energy resources from the Gulf of Mexico. It is important to note, however, that even in these historically significant spill cases, the damages to the tourism and recreational industries were temporary (less than one year). Findings from an in-depth study of the impact of the IXTOC 1 oil spill on three south Texas shorefront beach parks indicated no significant decrease in park visitations resulting from the oil spill (Freeman et al., 1985).

Section IV.B. presents available information on the historic oil spills from OCS operations in the Gulf, discusses the OSRA developed for this EIS, and provides information on the extent and effectiveness of existing containment and cleanup capabilities. Most relevant to this impact analysis are the assumptions concerning the characteristics and fates of a Gulf of Mexico oil spill, indicating that the majority of oil spills occurring in the Gulf are likely to dissipate rapidly and only a relatively small fraction is subject to tar ball formation because of the chemical properties of many northern Gulf light crudes. Tar balls are known to remain viable as long as 1-2 years in the marine environment. The analysis of major spills assumes that an originating slick remains an acute threat to shoreline recreational resources for up to 10 days after which natural processes have significantly changed the nature and form of the pollutant to the point that it is unlikely to be a major threat to beach recreational resources and activities.

Table S-4 lists the definitions for the five levels of impact used in the analyses and conclusions.

Base Case Analysis

Exploration and production on blocks leased in the Central Gulf of Mexico will result in some ocean litter and could lead to large oil spills (21% probability) (Table IV-5). Spills and debris could be carried by wind, wave, and currents to interact with major shorefront recreational beaches throughout the Gulf of Mexico. As was made evident from the Alvenus tanker accident, major oil spills occurring in one region (CPA) can impact recreational resources and activities in another region (WPA). As noted on the back of Visual No. 7, the predominant direction of wind and current in the Gulf of Mexico is to the northwest.

Oil spills contacting recreational beaches can cause short-term displacement of recreational activity on the areas directly affected; however, the quantity, quality, or use of the affected beach environment would not be changed in a sustained manner. Should major beaches such as Ship Island in Mississippi, Grand Isle in southeastern Louisiana, or Holly Beach in southwest Louisiana be contacted by a large oil spill during the summer, some short-term adverse social and economic impacts (tourism) would be realized throughout the local beach support community and some quick-fix remedies such as sand removal and associated disposal problems would ensue. The OSRA estimates (Tables IV-7 and IV-8) indicate the proposed action is unlikely (up to 2% chance) to result in a large oil spill (1,000 bbls or greater) occurrence and contact (within 10 days) with any major recreational beach anywhere in the Gulf region. It is assumed, therefore, for purposes of this analysis that a large oil spill will not impact recreational beaches in the CPA or WPA from operations resulting from this proposed action.

As noted in Section IV.B.2., a small spills each year in the size class > 1 and ≤ 50 bbls 50 and one spill of > 50 and < 1,000 bbls during the 34-year lease life are expected to occur from operations, and a few chronic spills (> 1 and ≤ 50 bbls) are assumed to contact recreational beaches during the 34-year lease life. Such spills can be cleaned from recreational beaches with little disruption of normal recreational activities and with minimal effects on beach recreational resources.

Some litter from OCS accidents, carelessness, and noncompliance with OCS antipollution regulations and directives is likely to come ashore on recreational beaches from OCS operations. New training and industry awareness programs focused on the beach litter problem is expected to minimize the level of indiscriminate and irresponsible trash disposal and loss from OCS oil and gas operations. The same beaches potentially affected by oil spill contacts (Table IV-7) would likely be impacted by intermittent trash and debris. Incremental effects from the proposed action on litter are unlikely to be perceptible by beach users or administrators because the OCS activity will constitute only a very small percentage of the existing OCS activity in the CPA and is likely to be offset by the number of terminating leases in the next few years. Litter on recreational beaches from OCS operations will adversely affect the ambience of the beach environment, detract from the enjoyment of beach activities, and can increase administrative cost on maintained beaches.

Conclusion

The proposed action is expected to result in a low impact on the quantity, quality, and use of recreational beaches in Louisiana. Little or no impacts are estimated for major recreational beaches in Mississippi and Alabama; however, persistent litter and debris lost from OCS operations in the CPA, as a result of Sale 123, are expected to cause a very low level of impact on Texas shorefront beaches.

Cumulative Analysis

This cumulative analysis considers the effects of impact producing factors related to the proposed action plus those related to prior and future OCS sales, State offshore oil and gas activity, tankering of crude oil imports, merchant shipping, commercial and recreational fishing, defense operations, and other offshore and coastal activity which results in debris, litter, trash, and pollution that may occur and adversely affect major recreational beaches in the CPA. Specific impact producing factors analyzed include oil spills, trash and debris, recreational use, land development/alteration, and erosion.

A mean number of three large oil spills (1,000 bbls or greater) (Table IV-7), a few spills each year of the size class > 1 and ≤ 50 bbls, and a few spills during the 34-year lease life of > 50 and < 1,000 bbls are assumed to occur and contact major shorefront recreational beaches in the potentially affected coastal area extending from Texas through Florida as a result of Federal OCS activity and offshore crude oil import tankering. Such spill contacts would occur between 1990 and 2024 and are most likely to affect major recreational beaches at Galveston Island and Padre Island National Seashore in Texas and at Cameron, Fourchon, and Grand Isle Beaches in Louisiana. Major spill contacts are expected to result in short-term disturbances, causing temporary loss or displacement of water-related, nearshore recreational activity on specific beaches directly or indirectly impacted. Furthermore, 15 large tanker spills (Section IV.B.1.) carrying imported petroleum liquids could adversely impact beaches in the vicinity of major inshore Gulf of Mexico ports. It is important to realize, especially in the cumulative impact context, that of all chronic hydrocarbon pollution existing in the Gulf, less than 1% is directly related to Gulf of Mexico oil and gas leasing and production (Section IV.A.2.c.). Chronic hydrocarbon pollution can manifest itself as tar balls on beaches, which would adversely impact beach users, recreational developments, and personal property.

Continued and expanded oil and gas operations in the CPA have contributed to the already serious problem of debris and trash on coastal beaches. This detracts from the aesthetic quality and can be hazardous to beach recreational activity and increase the cost of beach maintenance programs. Other factors such as merchant shipping, Naval operations, offshore commercial and recreational fishing, natural phenomena, recreational use of beaches, State oil and gas activity, tankering, pipelines, operational discharges, condos, coastal activity in Mexico and Cuba, and other offshore and coastal activities contribute to the flotsam, jetsam, pollution, and litter currently existing on the major recreational beaches of Louisiana, Mississippi, and Alabama. Although trash and debris are a recognized problem affecting enjoyment and maintenance of recreational beaches in the CPA, very little data exist which indicate what percentage of beach litter is associated with OCS oil and gas operations.

A recent publication (Lindstedt and Holmes, 1988) reporting on the data collected by hundreds of volunteers during the 1987 Louisiana "September Sweep" beach cleanup documented the removal of an estimated 200 tons of trash and debris from 60 miles of Louisiana's recreational shorefront. This report provides insight into the magnitude and composition of the cumulative trash and debris affecting Louisiana's beaches. As a result of the 1987 statewide cleanup and other State investigations, the Louisiana Geological Survey determined 5,000 to 23,000 pieces of litter were impacting each mile of Louisiana beach. Data synthesis indicates the problem is both onshore and offshore in origin and has local, regional, national, and international implications. Coastwide, 65% of the trash items were made of plastic or polystyrene followed by metal (13%) and glass items (12%). Styrofoam cups (polystyrene) were the most common item found along Louisiana's beaches. In fact, over one-third (37%) of the articles littering Louisiana's beaches are drink-related trash or garbage items (cups, beer and soft drink containers, milk jugs, six-pack rings). Although beach users and all offshore user groups and industries (shipping, petroleum, fishing, military) are known contributors to the problem, the level of contribution by each industry or its subcomponents is unknown. Litter with labels representing 17 foreign counties was identified but comprised less than 1% of the items collected. Four items (hard hats, pipe thread protectors, drums, and computer tape write-protect rings) were used as indicator items most directly perceived to be associated with the offshore oil and gas industry. Although the State's final report assigns between 2%-4% of all litter items to the oil and gas category, this is a deceptive number as regards their cumulative contributions and culpability to the beach trash load. All of the other categories (beverage-related items, galley wastes, operational wastes, fishing gear, personal items, and unknown) include articles that could also be from the offshore petroleum industry, their contractors, and employees. Conversely, other industries or individuals use or transport drums offshore and may be responsible for their loss or disposal in the marine environment. Items such as hard hats (58 recorded/2 per mile); pipe thread protectors (160 recorded/2.6 per mile); write-protect rings (180 recorded/3 per mile), and drums (122 recorded/2 per mile) are indicative of a significant level of oil and gas activity occurring in the CPA and the need for better control and handling of these items when used offshore.

In 1985, the oil and gas industry initiated special efforts consisting of training, operational practices, and offshore worker awareness programs to minimize irresponsible offshore trash disposal associated with OCS operations. In 1986, the MMS issued NTL 86-11 officially informing all leaseholders of the coastal debris problem and requiring OCS oil and gas operators to take special educational and operational measures to minimize or eliminate their contribution to this problem.

In 1987, the Director of MMS formed and convened a Gulfwide Take Pride Task Force specifically to encourage the combined resources of all Gulf users, regulators, and concerned environmental groups to effect solutions to the marine debris problem. Also in 1987, the U.S. ratified a provision (Annex V) of an international agreement (MARPOL) established to control pollution from ships worldwide. As a consequence of this ratification, the U.S. Congress enacted the Marine Plastic Pollution Research and Control Act of 1987 at the end of the year. This Act includes a total prohibition of dumping any plastics by any U.S. boat, vessel, or ship in any U.S. waters and restricts the dumping of other solid waste materials in U.S. waters. These provisions go into effect at the begining of 1989. In May 1988, a report from the Interagency Task Force on Persistent Marine Debris was endorsed by the President's Domestic Policy Council, published, and distributed to targeted Federal agencies. This report calls for concerted Federal leadership in attacking marine debris through education, awareness, research, monitoring, enforcement, and beach cleanups. The U.S. Coast Guard, NOAA, and USEPA have and are continuing to initiate major projects and programs designed to reduce and mitigate marine debris in the Gulf of Mexico.

As noted in their report at the 1987 MMS Information Transfer Meeting (Proceedings . . ., 1988, pp. 65-70), the oil and gas industry accepted responsibility for a portion of the debris problem impacting recreational beaches in the CPA and WPA and adopted a course of action reflective of the recommendations endorsed by the Domestic Policy Council and the directives and suggestions of MMS. Specifically, the petroleum industry has developed award-winning training aids and awareness products focused on marine debris and its consequences, and has incorporated these aids in company antilitter directives in their regular employee and contractor orientation, training, and operational programs and manuals. Several companies have incorporated specific contractual language prohibiting disposal of all solid waste in the marine environment as a condition of offshore support and service contracts; petroleum industry volunteers comprised 24% of the Louisiana participants and 48% of [illegible] Alabama participants during the September 24, 1988, Take Pride Gulfwide Beach Cleanup; and oil companies provided a majority of the contributions, supplies, equipment, and support of the 1988 Cleanup throughout the CPA; three oil companies are responsible for one-half of the miles (8 miles) currently under custodial care in the Louisiana Beach Adoption Program; and two major offshore companies have discontinued the use of styrofoam cups in their offshore operations. Additionally, MMS and the oil companies have put additional emphasis over the last two years on enforcement and compliance with pertinent regulations and policies associated with this issue (drum markings, for example). The educational and awareness activities directed at all commercial and recreational users of the Gulf of Mexico, along with the international adoption of Annex V (MARPOL Treaty) prohibiting the disposal of any plastics in the marine environment and the U.S. support of Special Area Designation for the Gulf of Mexico prohibiting the disposal of all solid waste materials into the Gulf of Mexico, as well as the obvious institutional commitment of the oil and gas industry to solve and mitigate this problem, are expected to significantly reduce the cumulative trash lode entering the Gulf by the early 1990's.

Beach erosion is a significant problem for many of the potentially affected recreational beaches in the Gulf region and is expected to continue over the next 20 years. Although the erosion problem is primarily the result of natural processes/events, it can be exacerbated by construction and maintenance activity related to continued offshore oil and gas development. Section IV.D.1.a.(1)(a) discusses in some detail the impacts of oil and gas activities on coastal barriers.

Conclusion

The level of cumulative impact on recreational beach use in the CPA is estimated to be moderate, resulting from chronic trash and marine debris, oil spills, other pollution events, coastal erosion, and increased public use of beaches.

High Case Analysis

Based on the High Case outlined in Table IV-1, there could be approximately 1.7 times the offshore activity and double the oil production associated with the Base Case; therefore, the potential for oil spills and trash loss should be about one and three-fourths to two times that of the scenario resulting from the proposed action.

The chance under the High Case that a large spill will occur and contact major recreational beaches anywhere along the Gulf shorefront does not significantly change from the Base Case. Therefore, the recreational beaches of Louisiana, Mississippi, Alabama, Texas, and Florida show very little, if any, incremental risk of contact from large oil spills (Tables IV-7 and IV-8). Small spills, together with trash and debris problems associated with sale-specific operations, are expected to cause intermittent aesthetic and maintenance problems on Louisiana and Texas beaches.

Conclusion

The impact on recreational beach use in the CPA and WPA as a result of the High Case is expected to be low.

(10) Impacts on Archaeological Resources

Impacts to archaeological resources could occur as a result of an actual physical destruction of an artifact; the disruption of the horizontal and vertical matrix of artifacts, sediments, and paleoindicators from which the scientific value of the archaeological resource is derived; and contamination of organic site material with hydrocarbons, which could destroy the C-14 dating potential of the material. The major impact producing factors that could threaten archaeological resources include physical destruction or disruption from placement of drilling rigs, production platforms, and pipelines; impacts from anchoring activities; and impacts from oil spills. The OCS oil and gas activities will also generate tons of ferromagnetic structures and debris, which will tend to mask magnetic signatures of significant historic archaeological resources. The task of locating historic resources through an archaeological survey is, therefore, made more difficult as a result of leasing activity.

(a) Historic

Base Case Analysis

Of the 1,589 ships known to have sunk in the northern Gulf of Mexico between 1500 and 1945, the locations of only 110 are known with sufficient accuracy to permit reliable mapping (Table III-17 of Final EIS 110/112). Of these 110 shipwrecks with known locations, 51 occur within the CPA. Four of the 51 ships date from the nineteenth century, one dates from the eighteenth century, and the remainder are twentieth century ships (Table III-19 of Final EIS 110/112).

The eighteenth century shipwreck, the *El Constante*, is the only one of the 51 shipwrecks in the CPA with a known location that has been groundtruthed and evaluated for National Register eligibility. No impact to this site should occur as a result of OCS activities because a complete excavation of the galleon has been completed by the State of Louisiana and because the site is located within State waters. Although the probable remains of several of the twentieth century ships have been located from postlease archaeological resource surveys, no groundtruthing of these sites has been done. The historical significance of these twentieth century ships is probably low, and most would not qualify for inclusion in the National Register of Historic Places.

Although relatively precise locations are known for only 51 potentially significant shipwrecks in the Central Gulf, a high probability zone (Archaeological Resources Zone 1) for the occurrence of wrecks was established during the archaeological resources baseline study (CEI, 1977). The MMS is currently funding a study (Contract No. 14-12-0001-30330) that will reevaluate the current boundary of Archaeological Resources Zone 1. The results of this study should be available for inclusion in Final EIS 123/125.

Offshore development could result in an interaction between a drilling rig, platform, pipeline, or anchors and an historic shipwreck. This direct physical contact with a wreck site could destroy fragile ship remains, such as the hull and wooden or ceramic artifacts, and could disturb the site context. The result would be the loss of archaeological data on ship construction, cargo, social organization of the vessel's crew, and the concomitant loss of information on maritime culture for the time period from which the ship dates.

Since likely locations of archaeological sites cannot be delineated without first conducting a remote sensing survey of the seabed and near-surface sediments, MMS, by virtue of the Archaeological Resource Stipulation, requires that an archaeological survey be conducted prior to development of lease tracts within Archaeological Zones 1 and 2. Generally, in the eastern part of the CPA where unconsolidated sediments are thicker, it is likely that side scan sonar, which has limited penetrability, will not detect shipwrecks buried beneath the mud. In this area, which begins around South Marsh Island Area and extends eastward (subplanning areas C-2 and C-3), the effectiveness of the survey for detecting historic shipwrecks of composite and wooden construction would depend on the capability of a magnetometer towed at a 150-m linespacing (as specified in the archaeological survey requirements) to detect magnetic objects of the size characteristically associated with shipwrecks. Clausen and Arnold (1975) have concluded that magnetometer reliability for detecting ferrous objects under these conditions is 25%-30%. Although the potential for a direct physical contact between an impact producing factor and a shipwreck is unknown in this area, the survey would reduce the potential for an interaction by only 25%-30%. Therefore, in the eastern part of the CPA, there would still be the potential for a high to very high impact.

In the western part of the CPA, where shipwrecks are more likely to be detected by side scan sonar, the potential for a direct physical contact between an impact producing factor and a shipwreck would be reduced by an estimated 90%. Therefore, the effectiveness of the survey would reduce the potential impact to historic shipwrecks in the western part of the CPA to very low. Thus, the composite level of impact in the CPA would be very low, except in subplanning areas C-2 and C-3 where the impact is uncertain but could be high to very high.

Onshore historic properties include sites, structures, and objects such as historic buildings, forts, lighthouses, homesteads, cemeteries, and battlefields. Sites already listed on the National Register of Historic Places and those considered eligible for the Register (Visual No. 3) have already been evaluated as being able to make a unique or significant contribution to science. Presently unidentified onshore historic sites may contain unique historic information and would have to be assessed after discovery to determine the importance of the data.

Onshore development as a result of the proposed action could result in the direct physical contact between the construction of new onshore facilities or pipeline canals and previously unidentified historic sites. This direct physical contact with an historic site could cause physical damage to, or complete destruction of, historic sites, structures, and artifacts, and could disturb site context. The result would be the loss of information on the history of the region and the Nation. Often, information contained in historical sites is previously undocumented in written accounts and may be the only surviving source of that information. No new onshore facilities or pipeline landfalls are projected for the Central Gulf for Sale 123. There is, therefore, no expected impact to onshore historic sites in the CPA from onshore development.

Should an oil spill contact a coastal historic site, such as a fort or a lighthouse, the major impact would be visual due to oil contamination of the site and its environment. This impact would probably be temporary and reversible with no actual loss of information. The impact of spilled oil as a result of the proposed action is, therefore, expected to be very low.

Since all platform locations within Archaeological Zones 1 and 2 are given archaeological clearance prior to setting the structure, removal of the structure should not result in any adverse impact to archaeological resources. This is consistent with the findings of the *Programmatic Environmental Assessment: Structure Removal Activities, Central and Western Gulf of Mexico Planning Areas* (USDI, MMS, 1987a).

Conclusion

The level of impact to historic sites in the Central Gulf as a result of the proposed action is expected to be very low, with the exception of impacts to historic shipwrecks in the eastern portion of the CPA. Here, the potential for an interaction is uncertain, but could be very high. A study recently completed by Texas A&M University for MMS will help to define more specific ares where a high impact level is possible. The results of this study should be available for incorporation into Final EIS 123/125.

Cumulative Analysis

The specific impact producing factors that are considered in this analysis are trawling, sport diving at archaeological sites, commercial treasure hunting, hurricanes, dredging, platform and pipeline emplacement, oil spills, and chronic hydrocarbon inputs to coastal waters.

The most intensive areas of trawling in the Central Gulf are represented by the areas occupying the centers of abundance for white shrimp (Visual No. 2). Extensive trawling within these areas would probably only affect the upper three inches or so of sediment (NERBC, 1980). Any shipwreck site components within three inches of the present seabed probably would be affected by trawling activities. At many wreck sites, this zone would already be disturbed by natural forces and processes, and the upper three inches of sediment would only contain artifacts of low specific gravity that have lost all original context and have probably been abraded (Muckelroy, 1978). The effect of trawling, therefore, on most historic shipwreck sites would probably be very low.

Sport diving and commercial treasure hunting are significant factors in the loss of historic data from wreck sites. While commercial treasure hunters generally work at wreck sites that contain items with high monetary value, sport divers may collect souvenirs from all types of wrecks. The impact of these activities cannot be quantified because their extent is unknown.

The half of the Central Gulf coast from the Atchafalaya Bay east to Alabama has been hit by 16 to 20 tropical cyclones between the years 1901-1955 (DeWald, 1980). The other half, west of Atchafalaya Bay, had a slightly lower incidence of 11 to 15. In addition, 7 major hurricanes crossed the Central Gulf between the years 1954-1977. Shipwrecks in shallow waters are exposed to greatly intensified longshore currents and wave impacts during tropical storms (Clausen and Arnold, 1975). Under these conditions, artifacts of relatively low specific gravities (e.g., ceramics and glass) will likely disperse, leaving only the denser materials (iron, steel, ballast, and conglomerates) at the original site. Some of the information contained in the site would be lost in this process, but a significant amount of information would remain. Overall, a significant loss of data has probably occurred and will likely continue to occur in the future as a result of tropical storm activity. Tropical storms will also affect historic coastal sites located onshore when the storm makes landfall. Assuming that some of the data that would be lost are unique, this impact would be very high.

Channel dredging activities have a high potential for impacts to historic sites because the dredge operates at the entrances to the ports, harbors, and bays where many shipwrecks have occurred. In many areas, however, the Corps of Engineers now requires remote sensing surveys prior to dredging to minimize impacts. This requirement will reduce future impacts, but there is a high probability that in the past dredging impacts have been large, which would have reduced the existing shipwreck resource base.

Future OCS exploration and development activities are expected to result in the drilling of 3,240 exploration and delineation wells and 5,340 development wells, the installation of 285 platforms, and the laying of 2,600 miles of offshore pipelines. The archaeological survey reduces the potential for an interaction between an impact producing factor and an historic shipwreck by 25%-30% in the eastern part of the CPA. Since this does not significantly reduce the potential for an interaction, the potential for an impact is high to very high. In the western part of the CPA, the potential for an interaction would be reduced by 90%. Since this is a significant reduction in probability, there is a low probability that a damaging interaction between an impact producing factor and a shipwreck will occur. Therefore, the potential impact to historic shipwrecks in the western part of the CPA should be very low.

According to Table IV-1, two service bases, each using 30 acres of land, will be constructed for OCS-related activities. Investigations prior to construction can determine if historical archaeological resources exist at the sites. The expected impacts to archaeological resources from these service bases are, therefore, anticipated to be low.

There are two projected pipeline landfalls in the Central Gulf under the cumulative scenario. Since MMS does not permit pipelines in State waters, the archaeological resource protection requirements of the National Historic Preservation Act (NHPA) are not within MMS's jurisdiction. However, other Federal agencies, such as the Corps of Engineers who lets permits associated with pipelines in State waters, are responsible for the protection of archaeological resources under the NHPA. Therefore, the impacts that might occur to archaeological resources by pipeline construction within State waters should be mitigated under the requirements of the NHPA.

Oil spills from a variety of sources (tanker spills at sea and in estuaries, pipeline leaks, well blow-outs, etc.) could occur and contact coastal archaeological sites under the cumulative scenario. This hydrocarbon contamination could have an impact on historic resources. However, since the impacts to historic sites from oil contamination are generally short-term and reversible, the expected cumulative impacts from oil contamination would be low.

Conclusion

The level of cumulative impact on the historic archaeological resource base in the Central Gulf is estimated to be very high.

High Case Analysis

The higher level of offshore development projected for the High Case would increase the potential for an interaction between an impact producing factor and an historic shipwreck. Should an interaction occur, the potential exists for the loss of significant or unique archaeological information.

The archaeological survey reduces the potential for an interaction between an impact producing factor and an historic shipwreck by 25%-30% in the eastern portion of the CPA. Since this would not significantly reduce the potential for an interaction, there would still be potential for a high to very high impact in the eastern part of the CPA. In the western portion of the CPA, the potential for an interaction would be reduced by 90%. Since this is a sufficient reduction in probability, it can be assumed that little damaging interaction between an impact producing factor and an archaeological site would occur. Therefore, the potential impact to historic shipwrecks in the western portion of the CPA should be very low.

Should an oil spill contact a coastal historic site such as a fort or lighthouse, the major impact would be visual due to oil contamination of the site and its environment. This impact would probably be temporary and reversible with no actual loss of information. Based on the criteria of significance outlined previously, the expected impact to coastal historic sites from an oil spill would be very low.

Conclusion

The expected level of impact to historic sites in the Central Gulf as a result of the High Case is very low, with the exception of impacts to historic shipwrecks in the eastern portion of the CPA. Here, the potential for an interaction is uncertain, but if an interaction with a significant shipwreck occurs, the impact is estimated to be very high.

(b) Prehistoric

Base Case Analysis

Prehistoric sites that are anticipated to occur offshore include all the types of sites that occur onshore, such as shell middens, campsites, kill sites, and tool manufacturing areas. Two possible prehistoric sites have been located on the OCS as a result of an MMS-funded study (CEI, 1986). These possible sites occurred in association with the ancient Sabine River valley offshore western Louisiana and eastern Texas. The results of this study indicate that with the right set of geologic and environmental conditions, prehistoric sites on the OCS may have survived marine transgression and may be able to be located and evaluated through seismic and sedimentary analyses.

Prehistoric archaeological sites on the OCS are important because the information that they may provide on prehistoric human migrations, settlement patterns, subsistence strategies, and cultural contacts across now submerged landmasses cannot be obtained from terrestrial sites. The information contained in these sites would, therefore, be scientifically significant and probably unique.

Offshore development as a result of the proposed action could result in an interaction between a drilling rig, platform, pipeline, or anchors at an inundated prehistoric site. This direct physical contact with a site could destroy fragile artifacts or site features and could disturb the site context. The result would be the loss of archaeological data on prehistoric migrations, settlement patterns, subsistence strategies, and archaeological contacts for North America, Central America, South America, and the Caribbean.

Likely locations for archaeological sites can be delineated with high-resolution seismic data. Operators are required, by virtue of the Archaeological Resource Stipulation, to conduct a remote sensing survey for unsurveyed lease blocks located landward of the Archaeological Zone 2 boundary because data of sufficient resolution are unavailable for most unleased areas of the CPA. The Federal Government's authority for archaeological resource management on the OCS is based in the requirements of the National Historic Preservation Act of 1966, as amended, Executive Order 11593, and the OCSLA, as amended (Section I.B.4.d.).

The archaeological surveys are estimated to be 90% effective in allowing identification and avoidance of high probability areas for site occurrence. Since this provides a sufficient reduction in the potential for an interaction between an impact producing factor and a prehistoric archaeological site, it can be assumed that little damaging interaction would occur. Therefore, the survey would reduce the potential impact to prehistoric sites in the CPA to very low.

Onshore prehistoric archaeological resources include sites, structures, and objects such as shell middens, campsites, kill sites, tool manufacturing areas, ceremonial complexes, and earthworks. Currently, unidentified onshore prehistoric sites would have to be assessed after discovery to determine the uniqueness or significance of the information that they contain. Sites already listed on the National Register of Historic Places, and those considered eligible for the Register (Visual No. 3), have already been evaluated as having the potential for making a unique or significant contribution to science. Of the presently unidentified coastal prehistoric sites that could be impacted by onshore development, some may contain unique information.

Onshore development as a result of the proposed action could result in direct physical contact between construction of new onshore facilities, or a pipeline landfall, and a previously unidentified prehistoric site. This direct physical contact with a prehistoric site could destroy fragile artifacts or site features and could disturb the site context. The result would be the loss of information on the prehistory of North America and the Gulf Coast Region. No new onshore facilities or pipeline landfalls, however, are projected as a result of Sale 123 (Table IV-1). There should, therefore, be no expected impact to onshore prehistoric sites in the CPA from onshore development.

Should an oil spill contact a coastal prehistoric site, the potential for dating the site using C-14 would be destroyed. If diagnostic artifacts are present in the site, however, loss of C-14 dating potential may not constitute a loss of unique information. Previously unrecorded coastal sites could also experience an impact from oil spill cleanup operations. Cleanup equipment could destroy fragile artifacts or site features and could disturb the site context. The result would be the loss of information on the prehistory of North America and the Gulf Coast Region. Some of the coastal prehistoric sites that may be impacted by beach cleanup operations may contain unique information. The probability of a large spill occurring and contacting a barrier beach in the CPA ranges from less than 0.5% for the Gulf Shores Coastal Barrier in Mississippi to 3% for the West Plaquemines Coastal Barrier (Table IV-7). Furthermore, it is unlikely that a small spill (50-1,000 bbls) will occur and contact the coastline during the 34-year lease life. The expected impact to coastal prehistoric sites from spilled oil is, therefore, expected to be very low.

All platform locations within Archaeological Zones 1 and 2 are given archaeological clearance prior to setting the structure; removal of the structure should not result in any adverse impact to archaeological resources. This is consistent with the findings of the *Programmatic Environmental Assessment: Structural Removal Activities, Central and Western Gulf of Mexico Planning Areas* (USDI, MMS, 1987a).

Conclusion

The level of impact to prehistoric sites in the Central Gulf as a result of the proposed action is expected to be very low.

Cumulative Analysis

The specific impact producing factors that are considered in this analysis are trawling, tropical storms, dredging, platform and pipeline emplacements, and oil spills and chronic hydrocarbon inputs to the marine environment.

Trawling activity in the CPA would only affect the upper three inches or so of sediment (NERBC, 1980). It is unlikely that this limited extent will affect any buried prehistoric sites.

The half of the Central Gulf coast from the Atchafalaya Bay east to Alabama has been hit by 16-20 tropical cyclones between the years 1901-1955 (DeWald, 1980). The other half, west of Atchafalaya Bay, had a slightly lower incidence of 11-15 tropical cyclones. In addition, seven major hurricanes crossed the Central Gulf between the years 1954-1977. Based on these figures, it is reasonable to assume that approximately 10 storms will affect the Central Gulf over the next 30 years. These storms affect coastal prehistoric sites on barrier islands and beach fronts by erosion and by the reworking of sediments, which would either destroy or change the context of site components. Assuming that some of the data that will be lost will be unique, this impact could be high.

Dredging activities occur mostly at entrances to ports, harbors, and bays. These would also have been sites favored by prehistoric populations that depended on the sea and trade for subsistence. In many areas, the COE now requires remote sensing surveys prior to dredging to minimize such impacts.

Future OCS exploration and development activities are expected to result in the drilling of 3,240 exploration and delineation wells and 5,340 development wells, the installation of 285 platforms, and the laying of 2,600 miles of offshore pipelines. The archaeological surveys are expected to reduce the potential for an interaction between an impact producing activity and a prehistoric resource by 90%. Since this is a significant reduction in probability, there is a low probability that a damaging interaction will occur.

Two new pipeline landfalls and two new onshore service bases are expected to be constructed as a result of OCS activities (Table IV-1). Each service base will utilize 30 acres of land. Each pipeline is assumed to utilize 0.25 acres of land at the landfall and an additional 40 acres if there is a pumping station associated with the pipeline. The pipeline will also disturb land during installation along its path through coastal habitats until it joins an existing pipeline system. The MMS has no regulatory authority onshore and cannot enforce existing archaeological protection requirements of the NHPA. Other Federal agencies, however, such as the Corps of Engineers, are responsible for the protection of archaeological resources under the NHPA. Pipeline and service base construction in onshore wetland areas should be mitigated under the requirements of the NHPA.

There is a high probability (62%, Table IV-7) that a large oil spill (1,000 bbls or greater) could occur and contact coastal archaeological sites in the CPA under the cumulative scenario. In addition, a few small spills > 50 and < 1,000 bbls could occur in each analysis area each year (Section IV.B.2.). This hydrocarbon contamination is much more significant in its potential impact to prehistoric resources than it was to historic resources. The most serious effect of oil contamination is the alteration of the carbon content of organic materials in coastal prehistoric sites. This contamination may result in erroneous C-14 dates and the possible loss of all dating potential for a site. Thus, the loss of significant, prehistoric site data could be very high.

Conclusion

The estimated level of cumulative impact on the prehistoric archaeological resource base in the Central Gulf is very high.

High Case Analysis

The higher level of offshore development projected for the High Case would increase the potential for an interaction between an impact producing factor and a prehistoric site. Should an interaction occur, the potential exists for the loss of significant or unique archaeological information.

The archaeological survey reduces the potential for an interaction between an impact producing factor and a prehistoric archaeological site by about 90%. Since this is a sufficient reduction in probability, it can be assumed that little damaging interaction between an impact producing factor and an archaeological site would occur. Therefore, the potential impact to prehistoric sites in the CPA should be very low.

Should an oil spill contact a coastal prehistoric site, the potential for dating the site using C-14 would be destroyed. However, if diagnostic artifacts are present in the site, loss of C-14 dating potential may not constitute a loss of unique information.

Previously unrecorded coastal sites may suffer direct physical impact from beach cleanup operations. Interaction of cleanup equipment with a site could destroy fragile artifacts or site features and could disturb the site context. The result would be the loss of information on the prehistory of North America and the Gulf Coast Region. Of the coastal prehistoric sites that may be impacted by beach cleanup operations, some may contain unique information; however, the probability of a large spill occurring and contacting archaeological sites is low (a 2% chance, Table IV-7). Furthermore, it is unlikely that a spill will contact the coastline during the 34-year lease life. Therefore, the expected impact to coastal prehistoric sites from an oil spill would be very low.

Conclusion

The level of impact to prehistoric sites in the Central Gulf as a result of the High Case is expected to be very low.

Impact Summary under Alternative A

Under Alternative A, the following resources and impact levels are noted: sensitive coastal habitats, whales, birds associated with the coastal area, the commerical fishing industry, and archaeological resources are very low; deepwater benthic communities (low density), water quality (coastal/nearshore and offshore), brown pelicans, sea turtles, marine mammals, and recreational beach use are low; live bottom areas, deepwater benthic communities (high density), and air quality are moderate; and topographic features is very high.

b. Impacts from Alternative B - Delete Biologically Sensitive Offshore Habitats

Impact Analysis

This deletion alternative, as described in Section II.A.2., would delete the 65 unleased blocks of the total 167 blocks (these blocks are listed in Appendix A) which are on or near enough to biologically sensitive areas of topographic features of the CPA so that activities resulting from the proposed action could have a high probability of impacting these biota. (There are 6,011 blocks to be offered in the Central Gulf.) The resource estimates for the proposed action would not be significantly reduced as a result of adopting this alternative. Therefore, the projected number of oil spills would also remain unchanged. Such a deletion would prevent any oil and gas activity whatsoever in the affected blocks (except for pipeline construction, which could be regulated through the normal pipeline permitting procedures); thus, it would eliminate any impacts to the biota of the area from oil and gas activities conducted within the blocks. Essentially, the blocks which fall within 3 nmi of the 85 m isobath of the 16 banks of the Central Gulf and 2 banks of the Western Gulf are considered potential sources of impact to biota of those banks which could be harmed by oil and gas activities. Deleting this small percentage of the Central Gulf area should result in a very large reduction of the potential impacts to these high value biological resources as compared with the proposal.

The biological resources of the topographic features are considered very sensitive to potential impacts due to oil and gas operations; thus, this deletion alternative is presented in order to fully protect these resources. The proposed biological stipulation discussed in Section II.A.1.c.(1), while reducing the expected level of impact to very low (if adopted), would not remove all risk.

To the extent that deletion of these few blocks will reduce the oil and gas exploration and development activities of the proposed action and to the extent that the resources expected to be impacted by the proposed action (such as endangered species, commercial and recreational fisheries, water quality, etc.) are found in those blocks, the impacts to those resources should be similarly reduced. Thus, adoption of this alternative and offering 6,011 blocks with only a small percentage of the Central Gulf area deleted (and no change in the resource estimates) would leave the impacts to all resources other than the topographic features unchanged from the proposal (Table S-2).

Conclusion

Adoption of this alternative will reduce the impacts to the biota of the topographic features to very low (from the very high of the proposal). However, the proposed biological stipulation (Section II.A.1.c.(1)), if adopted, will also achieve this reduction. The impacts to all other resoruces will remain the same as in the proposal.

c. Impacts from Alternative C - No Action

Impact Analysis

This alternative is equivalent to cancellation of the proposed action. The opportunity would be foregone or postponed for development of the estimated 0.17 BBO and 1.64 tcf of gas in the Central Gulf, which could have resulted from this proposed sale. This could cause alteration of the energy mix at the National/regional level and could exert movement toward other energy alternatives.

To delay or eliminate the proposed action, in part or in whole, would reduce future OCS oil and gas production in the short-term, necessitate escalated imports of oil and gas, and/or require the development of alternate energy sources to replace the energy resources expected to be recovered if the proposed sale takes place.

It is anticipated that the oil and gas that would become available from these proposed actions in the assumed time period could provide a significant contribution to this Nation's energy supply; if the proposed actions were canceled, the following energy actions or sources might be used as substitutes:

- energy conservation
- conventional oil and gas supplies
- coal
- nuclear power - fission
- nuclear power - fusion
- oil shale
- tar sands
- hydroelectric power
- solar energy
- energy imports
  - oil imports
  - natural gas pipeline imports
  - liquefied natural gas imports
- geothermal energy
- other energy sources
- combination of alternatives

Some of these actions are not feasible at this time and may not be during the estimated life of these production areas. A detailed description of energy alternatives is hereby incorporated by reference from Section IV.D.1.c. of Final EIS 113/115/116 (pages IV-157 through IV-175) and Appendix C, *Alternative Energy Sources*, of Volume 3 of the Final EIS for the Proposed 5-year OCS Oil and Gas Leasing Program, 1987-1992. The following is a summary of the alternative energy discussion.

Energy Conservation: Vigorous energy conservation is an alternative that warrants serious consideration. Several studies have suggested that we could enjoy the same standard of living and yet use 30%-50% less energy than we do now. Aside from these savings, it is not widely recognized that wasteful consumption habits impose social costs that can no longer be afforded, as do pollution and an inequitable distribution of fuel. Existing conservation programs include education, research and development, regulation, and subsidies.

In the residential and commercial sectors of the economy, more efficient energy consumption could be realized by improved insulation, more efficient heating and cooling systems, better designed appliances, and more efficient lighting. Incentives such as standards for improved thermal efficiency in existing homes and offices and minimum thermal standards for new homes and offices could also result in substantial energy savings.

In the industrial sector, more energy-efficient work schedules, better maintained equipment, equipment with better low-heat-transfer efficiencies, and recycled heat and waste materials could result in energy savings.

Transportation of people and goods accounts for approximately 25% of nationwide energy use. In the transportation sector, short- and mid-term conservation measures, such as consumer education, lower speed limits, and rate and service improvements on public transit and rail freight transit may achieve considerable energy savings. Other policies which could encourage fuel conservation in transportation include standards for more efficient new automobiles and incentives to reduce miles traveled.

Significant energy savings are clearly possible through accelerated conservation efforts. In addition, several of the strategies mentioned above have been at least partially implemented by the Energy Policy and Conservation Act of 1975 (P.L. 94-163).

The environmental effects of a vigorous energy conservation program will be primarily beneficial. The exact nature and magnitude of these effects will depend on whether there is a net reduction in energy use or whether the reduction is accomplished through technological change and substitutions. Either case would result in the reduction of pollutants such as CO, hydrocarbons, particulates, NO_x, and SO_x.

Conventional Oil and Gas Supplies: Reserves and undiscovered deposits of oil and gas still exist in the United States. Proved reserves are currently estimated at 31.4 BBO and 208.0 tcf of natural gas, the lowest level since 1951. Since 1970, new oil discoveries have replaced less than one-half of production.

Ultimately recoverable reserves (all deposits known or believed to exist in such forms that economic extraction is currently or potentially feasible), in addition to proved reserves, are estimated to be about 82.6 billion bbls of oil (54.6 onshore/28.0 offshore), 13 years of consumption at current rates, and 593.9 tcf of natural gas (426.9 onshore/167.0 offshore). This estimate is rising over time, mainly because of higher prices and new discoveries in unexplored areas. Unconventional hydrocarbons and recovery methods, especially enhanced recovery, could more than double these figures. The amount of ultimately recoverable reserves will depend on price, technology, geological information, and public policy such as price controls, access to Federal lands, and environmental standards.

Petroleum production is severely constrained in the short run and greatly affected by world prices in the long run. Although the long-run demand for fuel liquids is not forecast to decline significantly (feasible solid and gaseous substitutes do not appear to exist), consumption of conventional crude oil is expected to decline significantly as synthetic liquids are produced from shale, tar sands, and coal; as biomass sources are utilized; and as industry and utilities reduce oil facilities and shift to coal and possibly nuclear power. Synthetic liquid from coal is expected to be the major source of liquid fuel by 2020, supplying 50% of all liquid fuel and 10% of all consumed energy.

Conventional natural gas consumption is expected to decline due to depletion, higher prices, and competition with synthetic gas from coal. Enhanced gas recovery from unconventional sources such as tight sands and Devonian shale is expected to make a significant contribution to gaseous fuel production, providing 50% of all gaseous fuel and 5% of all energy consumption by 2020. Ultimately recoverable reserves from such sources are estimated at 3,000 tcf.

A detailed description of the crude oil and natural gas systems is found in Chapters 3 and 4 of *Energy Alternatives: A Comparative Analysis* (Oklahoma, University of, 1975).

To substitute directly for the proposed action, a combination of onshore and OCS production from other areas and continued foreign imports would be required to make up for the estimated total production of these proposed actions.

This substitution would entail environmental effects such as land subsidence, soil sterilization, and disruption of existing land-use patterns. Equipment failure, human error, and blowouts also may impair environmental quality. Moreover, poor well construction, particularly in older wells, and oil spills can result in ground- and surface-water pollution.

The water pollutants from onshore oil production are oil and dissolved solids. The amounts of each vary over a wide range. A summary of onshore oil pollutants is available in *Energy Alternative: A Comparative Analysis* (Oklahoma, University of, 1975).

Air pollutants (particulates, NO_x, hydrocarbons, and CO) result from blowouts and subsequent evaporation and burning. These are generally insignificant, except locally. Onshore or offshore effects are basically the same.

Given the fact that onshore supplies are dwindling, users of hydrocarbons from these proposed actions would have to continue their reliance on other regions and foreign imports for needed oil and gas. The decline in these supplies, even with energy conservation, could mean industrial shutdowns, increased unemployment, higher consumer prices, and changes in the standard of living. The lack of natural gas will mean additional use of "dirtier" alternative fuels (oil and coal) with consequent effects on air quality and human health.

Coal: Coal is the most abundant energy resource in the United States. Proven domestic reserves of coal are estimated at 438 billion short tons. This constitutes over one-quarter of the known world supply, 80% of proven United States fuel reserves, and 130 times the energy consumed in 1980. Ultimately recoverable reserves are estimated at 3.9 trillion short tons. A detailed discussion of the coal resource system can be found in Chapter 1 of *Energy Alternatives: A Comparative Analysis* (Oklahoma, University of, 1975).

Although domestic coal reserves could easily replace the energy expected to be realized from the proposed actions, serious limitations to coal development exist. In many uses, coal is an imperfect substitute for oil or natural gas. In many other cases, coal use and production is restricted by government constraints, limited availability of low-sulphur deposits, inadequate mining, conversion and pollution-abatement technology, and the hazardous environmental effects associated with coal extraction and from electricity generation. Coal production is also threatened by a unique set of labor problems associated with mining, and new, strict standard for coal-mine safety.

Due to its relative price advantage over other fuels, competitive market structure, and large resource base, coal consumption and production are expected to increase significantly and become the primary domestic energy source in the future.

Synfuels from coal also will be important. Synthetic oil and gas could contribute substantially to energy supplies by the year 2000. The most important contributions would be high Btu gas from coal, synthetic crude oil from oil shales, and coal liquefaction. The success of these energy sources will depend on developing technology, the cost of the effects, and the cost of conventional oil and gas. Technology for conversion of coal into gaseous and liquid hydrocarbons has been established for several decades, and a number of relatively low-capacity commercial plants exist in various parts of the world. However, few cost-effective advanced technologies have progressed beyond the pilot-plant stage.

Coal gasification can produce gaseous fuels with low, intermediate, or high energy content. Low and intermediate gases are produced in a two-stage process involving preparation and gasification, and the output is utilized as feedstock for electric generators. A third process, "upgrading," is required to produce high Btu gas, which produces an end-product usable by the consumer. Gasification processes have lower primary efficiency than direct coal combustion; more coal will have to be gasified to reach an equivalent Btu output. However, it is likely that coal gasification will achieve primary efficiencies of 70%, which is about twice that of coal to electricity end use.

Liquefied coal has the potential to replace conventional crude oil as the major source of liquid fuel and to provide 10% of total domestic energy consumption by 2020. The available technologies have a recovery rate of 0.5-3 bbls of oil per ton of coal processed. As with coal gasification, production of liquid fuels from coal requires either the addition of hydrogen or the removal of carbon from the compounds in the coal. Coal liquefaction can be accomplished by hydrogenation, pyrolysis, or catalytic conversion. Only catalytic conversion is in commercial operation.

Although United States coal resources are very large, as with other extractable mineral fuels, there is some geographic dislocation. Most of our new low-sulphur coal is found west of the Mississippi River or in Alaska, far from industrial areas. Also, much of the western coal is in arid or semi-arid areas where scarcity of water could constrain development.

If an alternative to the proposed OCS sale is greater reliance on coal, it may be expected that mining would have to increase in western states to provide the necessary fuel resources.

Adverse environmental effects from heavier reliance on coal would result from its direct utilization, surface mining, underground mining, transportation, and conversion to liquid or gaseous fuels.

Combustion of coal results in various emissions, notably SO_2 and particulates. If the expected production from these proposed actions are replaced by coal, there would be an increase in these pollutants, especially if coal is substituted for the natural gas presently used. Technology to control these emissions is available but has not yet been proven sufficient to be widely applied. Any large-scale shift to coal would require realization of emission regulations or improvement of technologies to convert coal to gaseous or liquid fuels.

The primary effect of surface mining is disruption of the land. This affects all local flora and fauna and water quality and increases landscape problems due to erosion and mine runoff. Reclamation is difficult in the western states due to the lack of water to assist in revegetation. Other problems include acid-mine-water drainage, leaching from spoil piles, processing waste, and disturbances caused by access and transportation. Noise and vibration resulting from operations also can be expected. Finally, surface mining causes conflicts with other resource uses such as agriculture, recreation, water, and wildlife habitat.

The land use of strip mining ranges from 0.8 to 5.9 acres/10^{12} Btu extracted, depending on seam thickness and Btu content of the coal.

Underground mining primarily affects land and water quality. The land effects are those that arise from subsidence, waste disposal, access, and transportation. Very little surface is disturbed. Subsidence can destroy structures, cause landslides and earthquakes, and disrupt groundwater circulation patterns. The amount of subsidence can be controlled by the mining method used and the amount of coal removed. The utilization of certain mining methods and the restriction of the amount of coal extracts can have detrimental effects on the economics of the operation.

Water quality is affected by processing waste and the draining of acid-mine-water into surrounding areas. These can be minimized through the proper methods of control both during and after operation. Waste piles can be replaced in the mine and the entrances sealed, which would also help to minimize subsidence. Other pollution problems are those associated with road and coal dust and the like, but these are minimal and easily controlled. Other disturbing aspects of mining have much less of an effect in an underground mine. Working conditions of underground mines have been improved under the Federal Coal Mining Health and Safety Act of 1969, although further efforts are needed to reduce health hazards. This program has resulted in increasing costs of underground mining when compared to surface mining, which has even more severe environmental consequences.

The five major coal transportation systems (road, rail, water, conveyor, and pipeline) all have some adverse environmental effects. These include air and noise pollution, safety hazards, landuse conflicts, trash disposal problems, and aesthetic damage. However, since spill problems are not associated with coal, most of the effects can be controlled with greater care and consideration. A slurry pipeline also requires large supplies of water and must adequately dispose of this at the other end. Water availability is a problem in many areas of the United States, especially in the west where energy resources requirements will have to compete with existing commercial and private users for a limited and fragile resource.

The environmental effects of coal gasification are those of mining plus those resulting from the production process. Water effects of processing can be minimized by recycling and evaporation. However, large inputs of water are required for some of the technologies, thus creating the potential for conflicts in water-short areas.

Air pollution could include sulphur dioxide, particulates, nitrous oxides, hydrocarbons, and carbon monoxides. Land effects results from solid-waste disposal plus land use for the plant, coal storage, and cooling sands, etc. Solid wastes include ash, sulphur, and minute quantities of some radioactive isotopes.

Again, the effects of liquefaction will be those of mining and those of the processing plants. Water effluents from liquefaction plants could contain amounts of phenols, solids, oil, ammonia, phosphates, etc. The waste water could be treated to remove most of these products.

Air pollution could result from particulates, nitrogen, sulphur oxides, and other gases. Pollution-control facilities would be required but would lower the economic attractiveness of the plants. Solid wastes would be mostly ash. If liquefaction plants were sited near mine openings, residue could be buried in the mines with little further environmental effects.

Nuclear Power - Fission: The predominant nuclear system used in the United States is the uranium dioxide-fueled, light-water moderated, and cooled nuclear power plant. Research and development is being directed toward other types of reactors, notably the breeder reactor.

Due to environmental concerns, the growth of nuclear energy may be slowing. At the end of 1980 there were 75 reactors in the United States, up from 19 in 1970. It is estimated that there are 108 nuclear power plants operating in the United States (Daniels, 1989). Although 4 reactors were licensed in 1980, 14 other planned units were canceled, and the Nuclear Regulatory Commission (NRC) closed 5 for modification to comply with revised seismic requirements and shut down 8 reactors comparable to Three Mile Island's to determine the probability for a similar accident and to make required safety modifications. Nuclear-energy output was down 1.6% in 1980. There are currently 102 reactors under various stages of construction, construction-permit review, or on order. Nuclear power development has encountered delays in licensing, siting, and environmental constraints as well as manufacturing and technical problems.

Future capacity will be influenced by the availability of plant sites, plant-licensing considerations, environmental factors, nuclear fuel costs, rate of development of the breeder and fusion reactors, and capital costs.

Domestic uranium resources are probably plentiful. Ultimately recoverable reserves are estimated to be 6.876 billion short tons, and large areas are unexplored. Twenty-one million short tons were consumed in 1980 domestic nuclear energy production.

Although fuel-cycle costs of nuclear reactors have increased only slightly in recent years, present trends in reactor capitol costs are significantly narrowing the economic advantage offered by fuel-cycle costs over coal- and oil-fired plants.

Although nuclear plants do not emit particulates or gaseous pollutants from combustion, the potential for serious environmental problems exists. Some airborne and liquid radioactive materials are released to the environment during normal operation. The amounts released are very small, and potential exposure has been shown to be less than the average level of natural radiation exposure. The plants are designed and operated in such a way that the probability of harmful radioactivity release from accidents is very low.

Nuclear plants use essentially the same cooling process as fossil-fuel plants and thus share the problem of heat dissipation from cooling water. However, light-water reactors require larger amounts of cooling water and discharge greater amounts of waste heat to the water than comparably sized fossil-fuel plants. The effects of thermal discharges may be beneficial in some, though not all, cases. Adverse effects can often be mitigated by use of cooling ponds or cooling towers.

Low-level radioactive waste from normal operation of a nuclear plant must be collected, placed in protective containers, and shipped to a Federally-licensed storage site for burial. High-level wastes created within the fuel elements remain there until the fuel elements are processed. Currently, spent fuel is stored at NRC-licensed facilities. Plans call for recovering unused fuels at reprocessing plants, solidifying the wastes, and placing them in storage at a Federal repository.

There are also effects on land, water, and air quality arising from the mining of these uranium ores. Dwindling amounts of high-grade reserves will increase the amount of land mined for lower-grade radioactive ores--primarily in western states. The mining operations will be similar to coal, but the nature and distribution of the deposits mean "lesser" effects while radioactive tailings cause unusual problems for disposal, the environment, and human health. A more complete discussion of uranium mining and processing, the economics and environmental impacts, as well as nuclear fission and fusion can be found in Chapters 6 and 7 of Energy Alternatives: A Comparative Analysis (Oklahoma, University of, 1975).

Nuclear Power - Fusion: The controlled fusing of atoms in a reactor is a long-term alternative energy source. Scientific feasibility has yet to be proven but looks promising. Technological and commercial feasibility will have to follow, however. The main obstacles are obtaining a high enough temperature and containing the reaction. It is unlikely that fusion will be available to any significant degree before 2025.

Fusion is attractive for two reasons--abundant fuel sources and relative safety. The reaction is fueled by deuterium and tritium. Deuterium exists naturally in seawater and would be nearly cost-free; tritium can be inexpensively produced in a reactor from lithium, which is plentiful.

Because of the small neutron activation involved in fusion reactions, there would be lower radioactive inventories, fewer radioactive wastes, and less serious fuel-handling problems and accident risks.

A proposed hybrid fusion-fission fuel cycle would fuel fission reactors with fusion-produced isotopes and multiply the energy release of fusion tenfold, while demanding less of the fusion core and thus enhancing the safety characteristics of both reactors.

A proposed pure deuterium process, while possessing a lower reaction rate, would have a neutron fuel cycle; thus, all particles and products would be electrically charged and there would, in theory, be no radioactivity.

The environmental risks from fusion energy are probably less than fission, but the degree of reduction and the social acceptability of that degree cannot be determined presently.

Oil Shale: Oil shale is a fine-grained, sedimentary rock which, when heated, releases a heavy oil that can be upgraded to synthetic crude oil. The technology for exploitation currently exists. The resource base for shale is very large, perhaps as much as 360 billion bbls.

Large areas of the United States are known to contain oil-shale deposits, but those in the Green River Formation in Colorado, Wyoming, and Utah have the greatest commercial potential.

Oil shale development poses serious environmental problems. With surface or conventional underground mining, it is very difficult to dispose of the huge quantities of spent shale, which occupy a larger volume than before the oil was extracted. Inducing revegetation growth in an area of oil shale development is difficult and may take more than 10 years. In-place processing avoids many of these environmental hazards. With underground mining, the spent-shale problem is much less severe.

Air pollutants from the mining will come from dust and vehicular traffic. These will be predominantly particulates, followed by NO_x and CO, with minimal amounts of hydrocarbons, SO_x, and aldehydes.

The mining of oil shale requires little water, both for operations and for reclaiming solid wastes. Water pollutants are considered negligible but may arise if saline water was encountered during the operations and had to be disposed of.

However, the processing (retorting) operations of oil shale consume large quantities of water and generate large amounts of waste water. The waste water must be treated and can be reused in the process. Therefore, it has been assumed that water pollution will not be a problem outside the complex. However, the limited availability of input water in the development area could lead to resource-use conflicts.

Air pollutants vary with the technology used. Solid waste comprises the greatest problem of oil-shale processing. The volume of the waste is greater than the volume of the input. Therefore, backfilling and the like would not provide a sufficient disposal space. Finally, there are the effects of access and of transporting the products. These are analogous to those of coal mining in the case of access and petroleum distribution in the case of transporting the product.

A more complete description of this energy source can be found in Chapter 2 of *Energy Alternatives: A Comparative Analysis* (Oklahoma, University of, 1975).

Tar Sands: Tar sands are deposits of porous rock or sediments that contain hydrocarbon oils (tar) too viscous to be extracted by conventional petroleum recovery methods. Large-scale production efforts have been developed in Canada, but United States' ventures have been minor. United States' resources are concentrated in Utah, with some potentially commercial quantities in California, Kentucky, New Mexico, and Texas.

About 1.5 tons of rich tar sands yield about 1 bbl of tar, or bitumen, the equivalent of about 6.3×10^6 Btu's. Tar can be recovered either from sands mined on the surface or underground or from direct underground extraction of the oil without mining. Recovery is followed by processing, upgrading to synthetic crude, and refining.

Ultimately recoverable reserves may be 100 billion bbls, including other heavy oils.

Surface mining produces substantial residuals, including modification of surface topography, disposal of large amounts of overburden, dust and vehicle emissions, and water pollution. Reclamation can minimize these effects. Residuals are similar to those of coal.

The effects of processing tar sands are similar to those of oil shale. These include solid tailings from extraction, cooling water and blowdown streams, thermal discharges, and off-gases. Under controlled conditions, these residuals can be minimized.

Underground extraction without mining can result in thermal additions, contamination of aquifers, surface spills, surface-earth movements, noise pollution, and emission of gases.

Hydroelectric Power: Hydropower is energy from falling water, which is used to drive turbines and thus produce electricity. Conventional hydroelectric developments convert the energy of natural-regulated stream flows falling from a height to produce electric power. Pumped storage projects generate electric power by releasing water from an upper to a lower storage pool and then pumping the water back to the upper pool for repeated use. A pumped storage project consumes more energy than it generates but converts offpeak, low-value energy to high-value peak energy. A more detailed discussion of this energy source is found in Chapter 9 of the *Energy Alternatives: A Comparative Analysis* (Oklahoma, University of, 1975).

Many of the major hydroelectric sites operating today were developed in the early 1950's. Thirty to forty years ago, hydroelectric plants supplied as much as 30% of the electricity produced in the United States. Although hydroplant production has steadily increased, thermal-electric-plant production has increased at a faster rate.

From 1970 to 1980, hydroelectric power production has fluctuated slightly between 220 and 300 billion kilowatt hours, about 4% of total United States energy production. As a proportion of total United States electricity production and installed generating capacity, hydroelectricity has dropped from 16% to 12%, although the latter has increased from 55.1-76.4 million kilowatts. Much of the recent hydroelectric development has been pumped-storage capacity.

It is likely that hydroelectric power will continue to represent a declining percentage of the total United States energy mix due to high capital costs, seasonal variations in waterflows, land-use conflicts, environmental effects, competitive water use, and flood-control constraints. Sites with the greatest production capacity and lowest development costs have already been exploited.

Construction of a hydroelectric dam represents an irreversible commitment of the land resource beneath the dam and lake. Flooding eliminates wildlife habitat and prevents other uses such as agriculture, mining, and free-flowing river reaction.

Hydroelectric projects do not consume fuel and do not cause air pollution. However, use of streams for power may displace recreational and other uses. Water released from reservoirs during the summer months may change ambient water temperatures and lower the oxygen content of the river downstream, adversely affecting indigenous fish. Fluctuating reservoir releases during peak-load operation also may adversely affect fisheries and downstream recreation.

Screens placed over turbines prevent the entrance of fish, but small organisms may pass through and may be killed.

Fish may die from nitrogen supersaturation, which results at a dam when excess water escapes from the draining reservoir. High nitrogen levels in the Columbia and Snake Rivers pose a threat to the salmon and steelhead resources of these rivers. Other adverse effects to water quality include possible saline-water intrusion into waterways and decreased ability of the waters to accommodate moderate waste discharges.

Air quality will be affected only by dust and emissions during the construction phase. Afterwards, if the impoundment is used for recreation, motor exhaust would occur.

Solar Energy: Applications of solar energy must take into account the following:

- Solar energy is a diffuse, low-intensity source requiring large collection areas. Only a small portion of the potential energy is utilized.
- Its intensity is continuously variable with time of day, weather, and season.
- Its availability differs widely between geographic areas.

Potential applications of solar energy show a wide range. Among them are:

- Thermal energy for buildings' water heating, space heating, space cooling, and combined systems
- Renewable clean fuel sources; combustion of organic matter; bioconversion of organic materials to methane; pyrolysis of organic materials to gas, liquid, and solid fuels; and chemical reduction of organic materials to oil
- Electric power generation, thermal conversion, photovoltaic-residential/commercial, ground central station, space central station, wind-energy conversion, and ocean-thermal difference

Solar-energy-collection systems are now commercially available nationwide.

Additional detail on this resource alternative is found in Chapter 11 of *Energy Alternatives: A Comparative Analysis* (United States Government Federal Policy Task Force Review Group, Solar Energy Analysis, 1978; *Solar Energy Progress and Problems*, 1978, EPA, USDOE, and Lawrence Berkeley Laboratories et al.).

Among the disadvantages of solar energy are high capital costs, expensive maintenance of solar collectors, thermal-waste disposal, and distribution for local thermal balances.

The environmental effects so far identified with solar energy are relatively minimal. The primary effects of the use of this energy source on a wide scale will be land use. Due to the low density of the energy, large areas will be necessary for the collectors. However, the land use compares favorably with other forms of energy use, such as coal extraction.

To date, the only other known area of concern is thermal pollution. Direct use in space heating has no thermal effects. However, some localized thermal pollution may occur from solar-electric-power generation, which will have to be collected and transferred to the generator; but the problem is not expected to be significant. Finally, solar plants can operate only intermittently. Thus, the energy will either have to be stored or backup fossil-fuel plants will have to be built. These will have their own sets of environmental constraints.

Oil Imports: Spurred by new discoveries and competition, Middle East oil production expanded in the 1950's and 1960's. New markets were opened and prices softened. The real price of oil fell from 1948 to 1972.

Simultaneously, United States consumption of oil increased while production stayed constant; imports were relied upon to make up the difference.

In 1973, the Arab-Israeli war was accompanied by an embargo imposed by OPEC against nations supporting Israel. The vulnerability of the importers to their own heavy demand became evident, and a huge price increase followed. This marked the end of the so-called era of "cheap energy," and efforts were made to curtail imports. Another large price increase occurred in 1979.

Three avenues were pursued for reducing imports: conservation, or reduced net-energy demand per unit output; alternative energy; and increased domestic production.

The results of these efforts for reducing imports seem to have been mostly successful. The underlying market structure for energy has been altered. World demand for oil peaked in 1977 and appears to be in an irreversible structural decline. Gross national products have been rising along with nonenergy output, alternative energy sources, and non-OPEC production. Oil is wholly responsible for declines in energy use.

OPEC produced 32 million barrels per day (mbd) in 1977. Current projections of energy consumption until the year 2000 show rates of one-half of that projected in 1972. The Department of Energy is currently projecting a 0.9% annual growth rate (actual growth was 1.9% annually from 1970-1979) and a 3% annual economic growth. The dimensions of the structural change for the United States in 1981 are as follows:

-- Total energy consumption was down 5%.

-- Petroleum consumption was down (8%) for the third straight year.

-- Oil consumption as a percentage of total energy consumption was down 9%.

-- Imports of petroleum were down for the fourth straight year. Imports in May 1981 were 5.2 mbd, the lowest in 10 years. This was 20% less than in 1980 and 38% less than in 1979.

-- Imported petroleum as a percentage of total petroleum consumption was down 5%.

-- Imported petroleum as a percentage of total energy consumption was down 27%.

-- Dollar of gross national product has been steadily declining since 1970.

It is reasonable to assume OPEC will affect the bulk of the world's oil production for the remainder of the century, due mainly to the short-term in elasticity of the supply of substitutes, and will set prices based on factors besides price/cost relationships. Brief derivations from this leadership position may be noted in the short-term due to world price adjustments. Thus, the less dependent the United States is on OPEC, the less vulnerable the United States is to large, erratic price changes. Imports from the Middle East also bring problems of stability of supply, balance of payments, currency exchange rates, and United States offloading capacity.

The United States will probably remain somewhat dependent on imported energy throughout this century and, as the 1970's showed, there are situations in the Middle East that could lead to major disruptions in supply or huge price increases. However, the propensity for such anomalies is less than in the past, due primarily to the following:

-- As mentioned above, the underlying market structure for energy has been altered and demand for oil has declined drastically. Associated with this, OPEC will have considerable spare capacity, and price cohesiveness will be difficult to maintain.

- All OPEC nations need to produce oil to finance development. The goal of many OPEC nations is to maximize oil's long-term contribution to the national economy rather than to maximize short-term profits. If revenue falls below a certain level where OPEC nations are not realizing an acceptable income, domestic tensions may ensue.

- The OPEC economies, especially Saudi Arabia's, are more interdependent with the West than previously. The OPEC has invested interest and financial reserves in the West, imports a large amount of goods from the West, and has its oil prices tied to Western currency-exchange rates.

- The presence of strategic stockpiles provides both a deterrent to international disruptions in world markets and a cushion for smoothing price and supply shocks. Current stockpile inventories of most Western nations are at record levels.

The OPEC's output and pricing structure also will depend on its balancing of:

- future vs. present proceeds;

- benefits vs. cost of rapid modernization; and

- discipline in the market vs. the political unit of OPEC.

The primary hazard to the natural environment of increased oil imports is the possibility of oil spills, which can result from accidental discharge, intentional discharge, and tanker casualties. Intentional discharges would result largely from uncontrolled unballasting of tankers. The effects of chronic, low-level pollution are largely unknown. The worldwide tanker casualty analysis indicates that, overall, an insignificant amount of the total volume of transported oil is spilled due to tanker accidents. However, a single incident such as the breakup of the *Torrey Canyon* in 1967 or the *Amoco Cadiz* in 1978 can have disastrous results. Of more concern than tanker spills is the effect on the social and economic environment. The potential for a future embargo under this option is such that American productivity and policy could become subservient to foreign influence, having both economic and security implications for the Nation. On a more subtle level, political alignments and policies of the United States could become tied to those of foreign oil powers. This option is the least acceptable for continued American energy independence.

Natural Gas Imports: Imports of natural gas via pipeline have come largely from Canada, with small amounts also coming from Mexico. In 1980, net pipeline imports from Canada were 881 billion cubic feet, about 4.4% of the total natural gas used in the United States. These imports were about 33% of Canada's natural gas production.

The natural gas import situation continues to be highly uncertain. A major reason for this uncertainty is the disparity between prices for natural gas and alternative fuels in this country and the price of crude oil in world markets.

The United States and Canada concluded an agreement in March 1980 that established a formula for escalating the price of Canadian imports. The formula prices Canadian gas at the Btu-equivalent price of Canadian crude oil imports, minus an adjustment that reflects savings to Canada of certain transportation costs. In response to escalated Canadian prices, demand in the United States for Canadian gas dropped sharply. Consequently, Canada has foregone the opportunity to raise its export price. What modifications, if any, the Canadians will make to their pricing formula and what minimum amounts of Canadian gas Americans must take under existing contracts are matters currently being examined on both sides of the border.

Mexico could be a significant source of future imports because of its relatively large natural gas resource base. Imports from Mexico were of a local nature until 1957 and have declined since 1969. In September 1979, an agreement was concluded between the United States and Mexico regarding the importation and pricing of natural gas. A base price was specified to be escalated in proportion to the average price of five crude oils traded on the world market. However, the rapid increase in world oil prices between the time the agreement was concluded and the time the price escalation began brought the price of Mexican gas substantially below both oil parity and the Canadian gas price. Consequently, Mexico requested and received the same price as the Canadians.

Natural gas imports are expected to be eliminated in the long run, as domestic natural gas production will nearly satisfy decreasing demand and synthetic gas from coal can provide the balance and replace imports.

The environmental effect of increasing gas imports derive mainly from the possible increase use of land for pipeline construction. A further effect is the risk of explosions and fires. Fluctuations of supply could influence quality of life, productivity, and employment. American policies also could become influenced by decisions of foreign gas producers; much as they could under the option of increasing oil imports.

Liquefied Natural Gas Imports: The growing shortage of domestic natural gas has encouraged projects to import liquefied natural gas (LNG) under long-term contract. Large-scale shipping of LNG is a relatively new industry. Several LNG projects are now under consideration on the Pacific, Atlantic, and Gulf Coasts. The security of foreign LNG is questionable. The complexity of the length of time involved in implementing these proposals has been increased by the need for negotiating preliminary contracts, securing the approval of the Federal Energy Regulation Commission and the exporting country, and making adequate provision for environmental and safety concerns in the proposed United States facilities. The authority to construct and operate facilities to implement imports and exports must be obtained separately from the Federal Energy Regulatory Commission. The cost of liquefying and transporting natural gas, other than overland by pipe, are high.

The United States imported 85 billion cubic feet of LNG from Algeria in 1978. In March 1980, Algeria announced that it was demanding oil-price parity, free-on-board, for gas it exported to the United States, and it subsequently discontinued deliveries. The free-on-board price does not include transportation, terminal, and regasification costs, which are substantial. Negotiations with the Algerians are in progress.

The environmental effects of LNG imports arise from tankers; terminal, transfer, and regasification facilities; and transportation of gas. The primary hazard of handling LNG is the possibility of a fire or explosion during transportation, transfer, or storage.

Receiving and regasification facilities will require prime shoreline locations and channel dredging. Regasification of LNG will release few pollutants to the air or water.

LNG imports will influence the United States balance of payments. This effect will depend on the origin and purchase price of the LNG, the source of the capital, and the country (United States or foreign) in which equipment is purchased and LNG tankers are built.

Geothermal Energy: Geothermal energy is primarily heat energy from the interior of the earth. It may be generated by radioactive decay of elements such as uranium or thorium and friction due to tidal or crustal plate motions.

There are four major types of geothermal systems--hot-water, vapor-dominated, geopressured reservoirs, and hot-dry-rock systems.

In addition to electricity, geothermal energy can offer a potential for space heating, industrial processing, and other nonelectric uses in many areas which presently are highly dependent upon oil and gas for energy needs. However, geothermal-electric generating plants are smaller than conventional plants and require a greater amount of steam to generate an equal amount of energy. This is due to the fact that temperatures and pressures associated with geothermal areas are lower than those created at conventional power plants.

The greatest potential for geothermal energy in the United States is found in the Rocky Mountain and Pacific regions; some potential (geopressured-geothermal) exists in the Gulf Coastal Plain of Texas and Louisiana. The geyser field in California, which has been producing power since 1969, is the most extensively developed source of geothermal energy in the United States. Exploration efforts are also underway in Imperial Valley, Salton Sea, Mono Lake, and Modoc County, California.

Geothermal energy presently accounts for less than 1% of total United States energy production. The environmental problems associated with geothermal energy principally result from a number of gases that are associated with geothermal systems and that may pose health and pollution problems. These gases include ammonia, boric acid, carbon dioxide, carbon monoxide, hydrogen sulfide, and others. However, adverse air quality effects are generally less than those associated with fossil fuel plants. Also associated with geothermal energy systems are saline waters that must be disposed of and isolated from contact with groundwater regimes.

Land quality problems stem from disturbance due to construction of related facilities and possible ground subsidence which, in turn, can cause structural failures and loss of groundwater storage capacity.

Other Energy Sources: The high cost and rapidly shrinking reserves of traditional energy fuels have encouraged research into new and different sources for potential energy. Some of these alternative sources have been known for decades, but high costs and technical problems have prevented their widespread use. These sources include tidal power, wind power, organic fuels, and ocean-thermal-gradients, among others.

The date of commercial availability of such alternatives will depend on the cost of the traditional energy fuels, the level of Federally-subsidized research through Energy Research and Development Administration assistance, and the solution of engineering and technical problems.

Environmental effects of these alternatives are difficult to assess, especially since a great amount of research and development remain to be completed before operational-scale systems can be developed, tested, and evaluated for production and application.

Combination of Alternatives: A combination of some of the most viable energy sources available to this area, discussed above, could be used to attain an energy equivalent comparable to the estimated production within the anticipated field life of these proposed actions. However, this combination of alternatives, in order to attain the needed energy mix peculiar to the infrastructure of this area, would have to consist of energy sources attainable now or within the suggested timeframe that are transferable to the technology presently used. Viable substitutes would have to be available for the petroleum and natural gas required by the petrochemical industrial complex, the petroleum used for the transportation sector, and the electricity and fuels used in residential and commercial sectors.

Part II of the *Energy Alternatives: A Comparative Analysis*, particularly Chapter 16, "Comparing the Economic Costs of Energy Alternatives," discusses the factors that must be involved in developing technically and economically appropriate energy alternatives.

Allowing favorable technologies and economies, the most viable domestically available energy alternative would probably consist of the use of coal, oil, shale, tar sands, and biomass to produce synthetic liquids; nuclear energy and coal to compete for the utility market; and renewables to supply a sizable portion of total energy requirements. The environmental effects of each of these alternatives have been discussed briefly in the previous paragraphs of this section. The rest will be a long-term energy-supply transition from crude oil and less dependence on oil imports. Such patterns will require new, efficient technologies, major capital investments, and a high rate of growth in coal production.

The future United States energy-source mix will depend on a multiplicity of factors--the identification of resources, research and development efforts, development of technology, rate of economic growth, the economic climate, changes in lifestyle and priorities, capital investment decisions, energy prices, world oil prices, environmental quality priorities, government policies, and availability of imports.

It is unlikely that there will ever be a single definitive choice among energy sources or that development of one source will preclude development of others. Different energy sources will differ in their rate of development and the extent of their contribution to total United States energy supplies. Understanding of the extent to which they may replace or complement offshore oil and gas requires reference to the total national energy picture.

It is difficult to predict the extent to which the development of alternative energy supplies may be necessary since other factors are involved, such as the continuing success of energy conservation by the American public, overcoming technical and economic barriers that presently exist in developing other alternative energy sources, and improving resource recovery methods to increase the rate of recovery. For more information on these alternative approaches to our Nation's energy needs, refer to the following: *Energy Alternatives: A Comparative Analysis* (Oklahoma, University of, 1975) which was prepared under contract for BLM; and *Final Environmental Statements for OCS Sale 58* (USDI, BLM, 1979); and *OCS Sale 70* (USDI, MMS, 1982).

The economic impacts of canceling of a sale could be far-reaching. Increased exploration activity on recently acquired leases could partially offset a one-year delay, resulting in negligible socioeconomic impacts. A lengthy delay, however, could seriously affect the economic stability of the coastal region, which is currently somewhat depressed. The infrastructure for oil and gas production in the Gulf of Mexico is highly concentrated in the coastal areas of Louisiana and Texas. The OCS oil and gas program is a major source of employment and revenue in the area. Cancellation of a sale could reduce the amount of exploration activity, the number of exploratory wells drilled, the number of workers and facilities employed by the industry, and the payroll and tax revenues generated.

All positive and negative impacts associated with the proposed action (as discussed in Section IV.A.1.) would be canceled.

Based on the resources estimated by MMS for the Base Case, Table IV-21 presents the energy equivalents that may be required from several alternatives energy sources should this lease sale be permanently cancelled. For the

Table IV-21

Replacement Energy Needs
Central and Western Planning Areas
(Base Case)

	Central Gulf Sale 123	Western Gulf Sale 125
Btu equivalents: *(trillion Btu)		
Oil - 0.20 billion barrels	952.0	
0.10 billion barrels		560.0
Gas - 1.85 trillion cubic feet	1,681.1	
1.52 trillion cubic feet		1,238.3
Oil equivalents: *(billion barrels)		
Oil from other sources needed to directly replace expected oil production	0.17	0.100
Oil from other sources needed to replace expected gas production	0.29	0.277
Gas equivalents: *(trillion cubic feet)		
Gas from other sources needed to replace expected oil production	9.750	0.530
Gas from other sources needed to directly replace expected gas production	1.646	1.470
Coal equivalents: *(billion short tons)	0.110	0.070
Electrical equivalents: *(billion watts per hour)		
Substitutes for end uses**	403.55	274.30
Substitutes for input to electricity generation***	248.34	168.76

Notes: *Conversion factor used:
1 barrel of oil = 5.6 x 10^6Btu.
1 cubic foot of natural gas = 1,021 Btu.
1 ton coal = 24 x 10^6
1 kilowatt hour = 3,412 Btu at the theoretical conversion rate of other energy forms of electricity at 100% efficiency.

**Based on a 65% average efficiency of end use of oil and gas(such as oil and gas heating) and a plant load factor of 80%.

***Efficiency of fossil fuel electricity generation was assumed to be 40%. The plant load factor equals 80%.

Source: USDI, Minerals Management Service, Gulf of Mexico OCS Region.

purpose of clarity, this table has separately identified each potential alternative source of energy regarding substitution requirements. It is unlikely, however, that there would be a single choice between these alternatives sources, but instead, some combined effort to further explore and develop many or all of these forms as a substitute for OCS oil and gas production.

Conclusion

If no action is taken on this sale, all environmental impacts that could have occurred under Alternative A will be avoided. Some adverse socioeconomic impacts could include a loss of employment opportunities, payroll revenues, and tax revenues.

d. Unavoidable Adverse Impacts of the Proposed Action

Sensitive Coastal Habitats: In the event an oil spill was to contact a barrier beach, the removal of beach sands alone during cleanup activities could result in such unavoidable adverse impacts. Likewise, if an oil spill contacted coastal wetlands, adverse impacts could be high and last up to 3 years.

Sensitive Offshore Habitats: Severe and perhaps permanent damage to the biota of topographic features could result if a blowout or seafloor oil spill were to occur in proximity to a topographic feature. Low relief topographic features could experience increased sedimentation and turbidity from unshunted drilling discharges. In addition, the proposed action, without the biological stipulation, could result in potentially permanent destruction of the productive biological habitats of the topographic features and live bottom areas due to mechanical damage from the unrestricted emplacement of rigs, platforms, and pipelines, and from the anchoring of industry vessels.

Water Quality: Normal offshore operations would have unavoidable effects to varying degrees on the quality of the surrounding water if the proposal is implemented. Drilling, construction, and pipelaying could cause an increase in the turbidity of the affected waters for the duration of the activity periods, and, in the case of pipelines, could disturb settled pollutants. A turbidity plume, several hundred meters in length, could also be created by the discharge of drill cuttings and drilling fluids. This, however, could only affect water in the immediate vicinity of the rigs. The discharge of treated sewage from the rigs and platforms could increase the levels of suspended solids, nutrients, chlorine, and BOD in a small area near the discharge points for a short period of time. Chronic spills from platforms and the discharge of formation waters could result in increases of hydrocarbon levels and possibly trace metal concentrations in the water column. Overall, the effect could be the degradation of water quality around platforms, although the extent of the impact will extend only from a few meters to a few tens of meters from the discharge site.

Unavoidable impacts to onshore water quality occurs as a result of runoff and effluent discharges from existing onshore infrastructure. Vessel traffic contributes to the degradation of impacted waterbodies through inputs of chronic oil leakage, treated sanitary and domestic waste, and contaminants known to exist in ship paints. Onshore water degradation is also occurring due to the discharge into Louisiana coastal waters of OCS produced waters. Additional impacts could result from increased sewage due to population growth in isolated communities. Regulatory requirements of the State and Federal water authorities and some local jurisdictions would be applicable to point source discharges from support facilities such as refineries and marine terminals.

Air Quality: Unavoidable adverse impacts to air quality could occur onshore adjacent to crude oil refineries, gas processing plants and areas of concentrated OCS activities. Unavoidable short-term impacts to air quality could occur near catastrophic events (oil spills, blowouts with fire, blowouts without fire) due to evaporation and combustion. Mitigation of long-term effects would be accomplished through existing regulations. However, short-term effects from nonroutine catastrophic events (accidents) are uncontrollable.

Endangered and Threatened Species: OCS-related oil/gas vessel traffic could result in some collision injuries to sea turtles. Removal of offshore oil/gas platform jackets/structures using explosive charges and seismic activities may cause injury or death to sea turtles and other marine life in the vicinity of the detonation. Oil spills could result in some injury or mortality to sea turtles and brown pelicans.

Marine Mammals: Some injury or mortality to marine mammals could result from OCS-related oil spills, collision with offshore support vessels, structure removals, and/or seismic activities.

Birds Associated with the Coastal Area: Some injury or mortality to birds associated with the coastal area could result in localized areas from OCS-related oil spills, pipeline landfalls and coastal construction, helicopter and OCS service vessel traffic, and oil/gas-related plastic debris.

Commercial Fishing Industry: Of the various types of fishing gear in use in the OCS areas, trawls have the greatest chance for operational conflicts with oil and gas activities. Losses may, however, be compensated under the Fishermen's Contingency Fund or other legal routes. Trawl nets can be snagged on underwater stubs causing damage or loss of the nets. In addition, it is conceivable that snags could damage underwater production equipment or pipelines causing a spill of oil and gas. Because safety equipment is installed, which shuts in production when a loss of pressure occurs, the likelihood of a major spill resulting thereby is considered very small. Less frequently, large objects which were lost overboard from petroleum industry boats, pipeline lay barges, and platforms are caught by fishing gear resulting in damage to the gear and/or its catch of fish; however, occurrence of this type of incident is low. Also, it is unlikely that commercial fishermen would harvest fish in the area of an oil spill, as spilled oil could coat or contaminate commercial fish species rendering them unmarketable. Other unavoidable adverse impacts include loss of fish space caused by installation of unburied pipelines, rigs, platforms, or by other OCS-related structures.

Major Shorefront Recreational Beaches: Even though existing regulations and orders prohibit indiscriminate littering of the marine environment with trash, offshore oil and gas operations involving men, machines, equipment, and supplies may result in some littering of the ocean. Human nature and accidents associated with offshore operations can contribute some floatable debris to the ocean environment which may eventually come ashore on major recreational beaches. Likewise, accidents can lead to oil spills which are difficult to contain in the ocean; therefore, it may be unavoidable that some recreational beaches become temporarily soiled by weathered crude oil.

Archaeological Resources: As a result of the proposed action, unique or significant archaeological information may be lost. The archaeological survey significantly lowers the potential for this loss by identifying potential archaeological sites prior to an interaction occurring, thereby making avoidance or mitigation of impacts possible. In some cases (e.g., in areas of high sedimentation rates), survey techniques may not be effective at identifying a potential resource.

e. Irreversible and Irretrievable Commitment of Resources

Wetlands: An irreversible and irretrievable commitment of biological resources could occur where wetlands are impacted by frequent oil spills and chronic low level contamination with oil. Repeated contact with oil can destroy wetlands vegetation which results in soil erosion and land loss.

Construction and emplacement of onshore support infrastructure and pipelines in coastal wetlands could result in the permanent loss of coastal wetlands due to mechanical destruction of plants and due to land loss facilitated by saltwater intrusion followed by erosion of marsh soils.

Sensitive Offshore Habitats: An irreversible and irretrievable loss of biotic resources would occur in areas subjected to intensive development. Oil spills and chronic low level pollution can injure and kill organisms at virtually all trophic levels. Mortality of individual organisms can be expected to occur, and possibly a reduction or even elimination of a few small or isolated populations. Section IV.D.1.a.(2) identifies the types of impacts which can occur and the resources which are particularly sensitive to adverse impacts resulting from the proposed actions. Adverse impacts resulting from the proposed action, without the biological stipulation, could be very high and potentially permanent.

Commercial Fishing Industry: Structure removal by explosives causes mortality to commercial fish species. Fish kills comprised predominantly of red snapper have been observed after explosives are used to remove structures in the Gulf of Mexico. If structure removal by explosives is continued, it will adversely impact the commercial fishing industry proximate to the removal site. However, in view of the positive impact the presence of offshore platforms, acting as artificial reefs and fish attracting devices, has on Gulf of Mexico commercial fishing (Section III.B.6.), continued structure removal, regardless of the technique used, will decrease the positive influence on commercial fishing from the presence of structures.

Archaeological Resources: Although the expected impact to archaeological resources as a result of the proposed action is uncertain, any interaction between an impact producing factor (drilling of exploratory, delineation, and development wells, placement of platforms, subsea completions, and pipeline installation) and a significant historic shipwreck or prehistoric site could destroy information contained in the site components and in their spatial distribution. This would be an irretrievable commitment of potentially unique archaeological data.

Local Employment, Income, and Population: The proposals could result in the production of certain OCS-related goods and services. To the extent that resources would be drawn away from other uses, production of goods and services in other areas of other types would be foregone. Steel products, specialized manpower, and capital constitute required resources which may be scarce; use of these resources for OCS needs means that other opportunities for their use might have to be foregone. While these resources may be reclaimed over time, their use as a result of the proposals would constitute an irreversible and irretrievable commitment of resources at a given point in time. To the extent that underemployed labor resources are used to fill new job opportunities, this would not constitute a cost to society in the form of foregone labor opportunities.

Oil and Gas Development: Leasing of the proposed blocks and subsequent development and extraction could represent an irreversible and irretrievable commitment of nonrenewable oil and gas resources. The estimated amount of resources recovered as a result of Sale 123 is presented in Table IV-1.

Loss of Human and Animal Life: OCS oil and gas exploration, development, production, and transportation are carried out under comprehensive, state-of-the-art, enforced regulatory procedures designed to ensure public safety and environmental protection. Notwithstanding, some loss of human and animal life is inevitable from unpredictable and unexpected acts of man and nature (unavoidable accidents, human error, and noncompliance, and adverse weather conditions). Some normal and required operations such as structure removal can result in the destruction of viable marine life. Although the possibility exists that individual marine mammals, sea turtles, and fish can be injured or killed, there is unlikely to be a lasting effect on baseline marine populations.

f. Relationship Between the Short-term Use of Man's Environment and the Maintenance and Enhancement of Long-term Productivity

In this section, the short-term effects and uses of various components of the environment of the Central Gulf Sale 123 area are related to long-term effects and the maintenance and enhancement of long-term productivity. The effects of the proposed action would vary in kind, intensity, and duration, beginning with preparatory activities (seismic data collection and exploration drilling) of oil and gas development and ending when natural environmental balances might be restored.

In general, short-term refers to the useful lifetime of the proposal, but some even shorter term uses and effects are considered. Long-term refers to that time beyond the lifetime of the proposal. The producing life of the field development in the Central Gulf Sale 123 area has been estimated to be about 34 years, based on the Base Case resource estimate. In other words, short-term refers to the total duration of oil and gas exploration and production, whereas long-term refers to an indefinite period beyond the termination of oil and gas production. The definitions for short-term and long-term as used in this section differ from those used in Section IV.D.1.a.

Many of the effects discussed in Section IV are considered to be short-term (being greatest during the construction, exploration, and early production phases), which could be further reduced by the mitigative measures discussed in Section II.A.1.c.

The principal short-term use of the leased areas in the Gulf under the proposed actions would be for the production of an estimated 0.17 BBO and an estimated 1.64 tcf of natural gas.

This activity could temporarily interfere with recreation and tourism in the region in the event of a major oil spill (1,000 bbls or more) contacting popular tourist beaches. The chance of one or more spills occurring and contacting popular tourist beaches within a 10-day period is 5% (Table IV-7).

The short-term recovery of hydrocarbons may have long-term impacts on offshore biologically sensitive areas (Section IV.D.1.a.(2)) or archaeological resources (Section IV.D.1.a.(10)).

The proposed leasing may also result in onshore development and population increases which could cause very short-term adverse impacts to local community infrastructure, particularly in areas of low population and minimal existing industrial infrastructure. However, these impacts should occur only in the very short run. A return to equilibrium could be quickly expected as population changes and industrial development are absorbed in expanded communities.

After the completion of oil and gas production, oil spills and their impacts would not occur, and the marine environment is generally expected to remain at or return to its normal long-term productivity levels. To date there has been no discernible decrease in long-term marine productivity in OCS areas where oil and gas have been produced for many years. Areas such as the Atlantic coast, which experienced repeated incidents of oil pollution as a result of tanker groundings during World War II, show no apparent long-term productivity losses, although baseline data do not exist to verify this. In other areas which have experienced apparent increases in oil pollution, such as the North Sea, some long-term effects appear to have taken place. Populations of pelagic birds have decreased markedly in the North Sea in recent years--prior to the beginning of North Sea oil production. Until more reliable data become available, the long-term effects of the chronic and major spillage of hydrocarbons and other drilling related discharges cannot be accurately projected. In the absence of such data, it must be concluded that the possibility of decreased long-term productivity exists as a result of the proposed actions.

The OCS development off Louisiana and Texas has supported recreational and commercial fishing activities. This has stimulated the manufacture and sale of larger private fishing vessels and special fishing and recreational equipment. Additionally, commercial enterprises such as charter boats have become heavily dependent on offshore structures for satisfying recreational customers. These proposed sales could increase these incidental benefits of offshore development. The platforms expected to result from the proposed actions could help replace those currently being removed where production has terminated. As the incidence of offshore fishing and diving has gradually increased in the past three decades, platforms (the focus of much of that activity) may eventually begin to gradually decline as mineral resources become depleted. In order to maintain the long-term productivity of site-specific, artificial locations attractive to fishermen and divers, some means, such as proliferation of artificial reef development programs, may need to eventually replace removed platforms.

Short-term environmental socioeconomic impacts could result from the proposed leasing schedule, including possible short-term losses in productivity as a result of oil spills. Long-term adverse environmental impacts are not expected if the archaeological and biological stipulations are adopted as part of the proposed action. However, some risk remains due to the potential for accidents. Oil and gas reserves could be lowered. Few long-term productivity or environmental gains are expected as a result of this proposed action; the benefits of the leasing schedule are expected to be principally those associated with a medium-term increase in supplies of domestic oil and gas. While no reliable data exist to indicate long-term productivity losses as a result of OCS development, such losses are possible.

2. Western Gulf Sale 125

a. Impacts from Alternative A - The Proposed Action

(1) Impacts on Sensitive Coastal Habitats

The major impact producing factors that could potentially affect sensitive coastal habitats are oil spills, pipeline emplacement, construction of onshore support facilities, construction of navigation canals, and maintenance dredging. The five levels of impact used in the analyses and conclusions are defined in Table S-4.

(a) Coastal Barriers

Barriers are inherently mobile landforms. For the purposes of this analysis, only changes that result in a reduction in the extent or size of the landform or one of its component environments will be considered an impact. Under natural conditions, barriers can continually adjust their plan and profile configurations in response to changing environmental conditions. Therefore, changes in the location or configuration of a landform that are not accompanied by a change in the extent of the landform will not be considered an impact. Rather, these changes are considered aspects of the natural behavior of the landscape.

Four factors have the most direct impact on changes in barrier landforms. An OCS activity that affects one of these factors or the way that a barrier feature responds to one of these factors could have an impact on a barrier landform. These four factors are discussed below.

Sand Supply and Distribution

In many cases, barrier landforms require a steady supply of sand in order to maintain their stability. Sand is needed to replace the sediments that are removed from the beach and transported either onto the continental shelf or across the island into the lagoon during storm events. Human activities have modified the sand budgets of many coastal barriers. Groins and jetties that have been installed perpendicular to the shore to stabilize beaches and harbor entrances at passes through barrier islands can interfere with longshore drift patterns and deprive updrift coastal areas of needed sediment. Sand can be removed from a beach as a result of oil spill cleanup procedures. Dams that have been constructed on upstream reaches of rivers that debouch directly into the Gulf have trapped sand-size sediments that ordinarily would be delivered to the coast.

Sea Level Rise

Bruun (1962) formulated that a barrier landform will migrate landward 2-3 orders of magnitude times the amount of vertical sea level rise along a coast with a gently sloping continental shelf. Numerous investigators have documented the validity of this principle. The ongoing eustatic sea level rise combined with geologic subsidence, therefore, contributes to the migratory behavior of barrier landforms in the Gulf of Mexico. This migration, however, will not necessarily result in the erosion of the landform because the entire form can move with no significant change in shape. If a barrier island is developed, however, and efforts are made to fix the location of the island to protect the structures built on it (roads, utility lines, marinas, offshore support bases, etc.), the island cannot migrate in response to rising sea levels and it will erode. Although OCS activities have no direct affect on relative sea level rise, the location of OCS-related support and processing facilities on barrier features, such as on Pelican Island, can indirectly lead to impacts associated with sea level changes because of the island stabilization structures needed to protect the facilities.

Energy Regime

A change in any climatic variable that affects the energy impinging on a barrier landform (waves, nearshore currents, winds) can alter the barrier landscape. A climatic change that would affect barrier stability would take place gradually over a long time period and need not be considered in the current analysis.

Vegetation

Sand dunes can be destabilized by weakening or destroying the vegetation that anchors the dunes in place. Vegetation can be affected by vehicle traffic or by an oil spill that is carried onto the dunes by a storm tide.

Base Case Analysis

The major impact producing factors associated with Sale 125 activities in the WPA that could potentially affect barrier landforms include pipeline emplacement, support infrastructure construction, navigation canal construction and maintenance, oil spills, and OCS trash and debris. The latter topic is discussed in Section IV.D.2.a.(9).

All pipelines that will be constructed to serve leases that result from the proposed action are expected to tie into existing trunk lines for transportation of the product to shore. Therefore, there should be no pipeline emplacement impacts to coastal barriers. If, because of unexpected discoveries, the need arises for more pipelines to come ashore, strategic routing and proper emplacement techniques should serve to minimize impacts.

No new ancillary facilities or new navigation canals are expected to result (Table IV-2). Maintenance dredging of existing navigation canals, however, will occur periodically. Changes in channel configuration can alter the littoral dynamics of the nearshore environment, which could endanger the natural deposition of sand/sediment and the self maintenance of its features.

Oil spills present a variety of threats to coastal barriers. The actual levels of impact will vary depending on the volume of oil contacting a particular area, the time of year, and the water stages. The Alvenus tanker oil spill, which occurred in 1984, can be used as an example of the impacts of a large spill event on a barrier beach. The size of the spill (as much as 65,000 bbls) ranks it as one of the largest spills to have occurred in the Gulf. Of the 20 large oil spills (1,000 bbls or greater) that have occurred in the Gulf as a result of OCS oil and gas production, only one has exceeded the magnitude of the Alvenus spill. Furthermore, efforts to intercept the oil from the Alvenus prior to its reaching the coast at Galveston Island were ineffective.

The greatest accumulation of oil occurred on Middle and Western Galveston Island. Road graders were used to move beached oil above the high tide zone. In all, 90,000 yds^3 of sand was removed from the beach. This amount of sand removal was considered equivalent to the amount that would be removed by a minor storm (McKinna, 1985). By comparison, Hurricane Alicia, a major Gulf hurricane, removed 900,000 yds^3 of sand from Galveston beach. The beach profile changed slightly as a result of the sand removal project, but this change was undetectable after a few spring tides. Furthermore, not all of the sand scraped from the beach was removed from the island environment. Sand that contained less than 10% oil concentration was put in the nontidal beach zone or in the back beach adjacent to sand dunes. Investigations at other oil spill sites have shown that much of the sand that is affected by oil can be cleaned and salvaged by appropriate sifting techniques (Gassman and Gunkel, 1983).

As noted in Table IV-8, the OSRA model indicates a very low percent chance (less than 0.5% to 2%) of a large oil spill occurring and contacting barrier beaches in the WPA. Furthermore, no spills of > 50 and < 1,000 bbls will contact the coastline during the 34-year lease life. Only one spill incident involving the size class of > 1 and ≤ 50 bbls is assumed to occur during that period. Another source of spilled oil that could contact coastal barriers as a result of the proposed action is spillage from shuttle tankers while they are navigating in coastal waters and estuaries. It is assumed that no oil spill greater than 50 bbls will occur and contact coastal barriers. The occurrence of and contact from one spill less than 50 bbls will not have an impact on barrier features in the WPA.

Conclusion

Impacts on coastal barriers as a result of the proposed action in the WPA are expected to be very low.

Cumulative Analysis

Specific impact producing factors that are considered in the analysis include sediment reduction, sea level changes, pipeline landfalls, navigation canals and facilities, oil spills, beach protection and stabilization projects, and recreational activities and land use.

Reductions in sediment supply along the Texas coast will continue to have a significant impact on barrier landforms. Dam construction on coastal rivers upstream has trapped sand-size sediments. The compartmentalization of the coast with groins and jetties has trapped sediment on the updrift sides of the structures. Seawall construction along eroding stretches of islands has reduced the amount of sediment introduced into the littoral system as a result of shore erosion. In addition, the Texas coast has experienced a natural decrease in sediment supply as a result of climatic changes that have occurred during the past few thousand years (Morton, 1982). Apparently, Texas rivers used to discharge considerably more water and sediment into the coastal zone.

The eustatic rate of increase in sea level that is affecting all coasts of the world is compounded along certain parts of the Texas coast where subsurface fluid withdrawals have caused land subsidence. As of 1977, however, subsidence induced by fluid withdrawal was assessed as being minor along much of the Texas coast (Morton, 1977). Continued withdrawals, however, could eventually cause additional decreases in coastal elevations.

Pipeline landfalls can affect barrier landforms in several ways. If the pipeline cut is not regraded to its original contour or if it is not revegetated, the landfall right-of-way can be an area of weakness that will erode or be washed over during storm conditions. Also, if the nearshore bottom topography is altered where the pipeline makes landfall, refraction patterns can change and possibly concentrate wave energy and encourage accelerated erosion at the landfall location. An ongoing MMS study, *Impacts of OCS Related Activities on Sensitive Coastal Habitats*, is investigating the full range of pipeline emplacement impacts on barrier landforms in the Gulf. The results of this study should be available for analysis for Final EIS 123/125. A total of 40 pipelines have made landfall in the WPA. Of these, 25 originated in State waters and 15 originated in Federal waters (Table IV-2). Many of these landfalls have occurred on barrier features. The impacts from these landfalls may have been large, particularly during the early years of the OCS program when environmental knowledge and regulations were rudimentary.

The addition of up to four new pipeline landfalls are estimated to result from future and prior OCS sales in the WPA. Current environmental regulations and pipeline emplacement techniques are sufficient for minimizing impacts from future pipeline projects. A 4" oil pipeline, for example, was installed across Timbalier Island, Louisiana, in 1984. As a condition of the permit, the trench could not be completely open across the island at any time (LeBlanc, 1985). This construction procedure was required in the event that a storm occurred prior to the completion and backfilling of the pipeline project. An open channel across the island could have severely eroded and even breached the island during a storm. Another permit requirement was that the pipeline route had to be revegetated after construction. Monitoring the revegetation and environmental change along the pipeline route since its installation in November 1984 indicates that revegetation and stabilization of the trench was rapid and occurred with no significant impact to the landform. The wetland areas in back of the island were the only setting that did not show rapid revegetation (Mendelssohn and Hester, 1988). This project shows that additional pipeline landfalls can be accommodated with little impact to barrier environments.

The construction and maintenance of navigation canals through barrier island passes can have impacts on the surrounding landscape. Stabilization of these channels with jetties can interfere with longshore sediment transport, resulting in the accumulation of sediments on the updrift side of the jetty and erosion on the downdrift side. Penland and Boyd (1982) have recommended that a sediment bypassing system should be employed around jetties in coastal Louisiana to eliminate this problem. The maintenance of dredged channels in these passes can alter coastal hydrodynamic processes such that net landward water movements through the channel can occur. Under these conditions the channels act as sediment sinks, removing littoral sediments from the longshore transport system. Although no new navigation canals are expected to result from the proposed action, the ongoing impact from existing channels is likely to affect barrier landforms in the WPA. Few, if any, new navigation canals are expected to be installed during the next 34 years for other purposes. The bases for this assumption are that the large number of existing navigation canals can accommodate future navigation needs and that current concerns about barrier island erosion and possible canal impacts on erosion do not favor the permitting of new canal projects. The selection of Ingleside, Texas, however, as a Navy Home Port will require dredging work through the Port Aransas channel. Also, future OCS leasing activity in deeper waters may utilize tankering rather than pipelines to bring the product to shore. This trend may require dredging work in channels to accommodate the increased vessel traffic. Channel modification could affect the sedimentology of the channels and longshore sediment transport processes.

The probability of contact between a barrier feature and spilled oil resulting from the proposed action, prior and future OCS leasing, and the tankering of imported oil is indicated in Table IV-8. The chance for the occurrence and contact of a large spill ranges from 4% for the Matagorda Island coastal barrier to 50% for the Galveston Island coastal barrier. The chance of contact from smaller spills and from shuttle tankers also increases compared to the Base Case. Although it is assumed that a spill will occur and contact a coastal barrier, the impacts from the possible spill are expected to be low based on the analysis of the effects of the Alvenus spill on Galveston Island, which showed no long-term impacts. Furthermore, Morton (1981), in a discussion of the factors that are causing landloss along the Texas coast, does not include oil spill impacts as a significant factor.

Efforts to stabilize the Gulf shoreline have had impacts on barrier landscapes. There are two approaches to beach protection and shoreline stabilization: rigid structures, such as jetties and groins, and nonrigid techniques, such as beach nourishment. Rigid approaches include devices to trap longshore sediments and structures to prevent erosion of the shoreline. Groins, jetties seawalls, and other engineering structures are designed to impede natural ocean forces and sand transport and to mitigate oceanic forces acting on the beach during storm conditions. Rigid engineering structures have often produced poor, and in some cases, deleterious results. Large amounts of money have been spent on structures to save the beach, but many are ineffective and some have aggravated existing problems. These structures have finite lives, are expensive to construct and maintain, and commonly transfer the erosion problem elsewhere by locally eliminating or reducing the sediment supply.

Structures that are constructed to stabilize the beach by fixing its location expose the landform to the erosive effects of a rising relative sea-level rise. Under natural conditions, barrier landforms will assume a low, streamlined profile in response to erosive wave attack and will migrate landward in response to inundation and erosion associated with a rising sea level. Fixing the shoreline causes a rising sea level to pile sediments against the shoreline, creating a steep berm-dune complex that is subject to wave attack. In some stabilized coastal areas, the entire beach has eroded away, leaving the seawall or duneline exposed to the direct attack of waves.

Dolan (1972) has suggested that dune stabilization programs that transplant vegetation to barren dune areas and that install snow fences to trap migrating sand may actually be encouraging erosion. The stabilized duneline may be functioning as a seawall by fixing the island in one location and keeping the landform from reconfiguring its profile when under storm attack. Mendelssohn (1982) reports, however, that dune stabilization projects throughout the United States have had positive impacts on beach stabilization and development, and that the use of vegetation for dune building and stabilization in Louisiana is an effective and cost-efficient erosion control method that is compatible with natural coastal processes.

The barrier islands in Texas are accessible for recreation because of their proximity to shore, their connection to the mainland in many cases, and the large population that inhabits the coastal counties in Texas. The Texas Open Beaches Act (1959) guarantees the public's right to unimpeded use of the State's beaches. It also provides for means of public acquisition of private beach property. Public recreation along the Texas coast is thus encouraged by the State. Recreational use of barrier islands can have impacts on the stability of the landform. Vehicle and pedestrian traffic on sand dunes can weaken the vegetation that binds and stabilizes the dune. Dunes that are affected in this way can be eroded by wind and wave forces. In 1973, Texas enacted the Sand Dune Protection Act, which authorized those counties with jurisdiction over coastal barriers to establish a dune protection line. Once such a line has been established, a permit must be obtained to disturb a dune or vegetation located seaward of the line.

During this century, the annual rate of coastal land loss in Texas has increased from 35 acres at the turn of the century to nearly 160 acres in 1980 (Morton, 1982). Since the turn of the century, the average position of the beach in Texas has retreated over 1,000 ft with erosion rates averaging 23-26 ft/yr. Impacts on barriers should continue because the impacting factors have not been mitigated.

Conclusion

The level of impact to barrier landforms is expected to be very high in the WPA.

High Case Analysis

No new support infrastructure, navigation canals, or pipeline landfalls are anticipated to be constructed in the Western Gulf coastal area as a result of the proposed action under the High Case (Table IV-2); therefore, impacts from these activities would be precluded. Some maintenance dredging of existing canals can be anticipated. As discussed previously, barrier features are relatively insensitive to oil spill impacts. The somewhat higher probabilities of an oil spill contact under the High Case compared to the Base Case will not, therefore, alter the impact level from oil spills from being very low.

Conclusion

The impacts of the proposed action under the High Case are expected to be very low.

(b) Wetlands

Base Case Analysis

The impacts of spilled oil on coastal marsh vegetation has been studied by a number of investigators in the Western Gulf coastal area. If a large spill or small spill greater than 50 bbls were to occur, the length of time for marsh vegetation to recover from an acute oil spill, in the absence of continued stress, is believed to be short. The NAS (1985) estimates that recovery will occur within one generation, or one year, for some grass species. As an example, in 1985 a pipeline break released 300 bbls of oil into a 50-acre area of marsh in Louisiana. Although the immediate impact on the vegetation in the area near the spill was considerable, the vegetation was expected to recover within 1-2 years (Fischel, 1987). Other studies in the Gulf of Mexico area have indicated only minor to moderate damage from oil spills (Delaune et al., 1979; Lytle and Lytle, 1987). In these investigations, death occurred only to heavily oiled shoots of contacted marsh vegetation, and the vegetation recovered within one or two growing seasons. In Texas, Alexander and Webb (1987) observed no affect on the growth of *Spartina alterniflora* from light oiling (less than 5 mg oil/g sediment) after a crude oil spill in Galveston Bay, Texas. Growth was significantly reduced in sediments with high oil content (5-51 mg/g), but this impact lasted through only 18 months. Shorelines with high oil concentrations experienced accelerated rates of erosion within 16 months of the occurrence of the spill. Accelerated erosion persisted for up to 32 months.

The response of marsh vegetation to an oiled environment also depends on the plant species that is being affected and the plant community structure. For some plants, growth stimulation occurred after oiling (Leenderste and Scholten, 1987). *Juncus roemerianus*, a common salt marsh plant found in the CPA and WPA, was found to take up hydrocarbons from contaminated water and sediment, and could remove oil from underlying sediments (Lytle and Lytle, 1987). In fact, uptake of oil from surrounding sediment and adsorption of oil on marsh vegetation and the subsequent formation of oil-laden detritus has been observed to be a major transport and dispersion mechanism for spilled oil in the wetland setting (Milan and Whelan, 1978).

Large oil spills that occur offshore as a result of OCS production would experience a greater amount of wave and tidal motions prior to reaching the coast than would spills that originate closer to shore. These oceanic processes would tend to spread the spill along the coast and reduce the concentration of spilled oil that occurred at any one location.

If a spill greater than 50 bbls were to occur offshore and reach coastal wetlands, the level of impact is expected to be moderate due to the fact that the greatest oiling would occur on coastal-fringing marshes. Much of the oil from the spill slick would spread out along the coast and not result in heavy oiling to most of the wetlands contacted. Some oil is expected to reach interior marsh, resulting in 1% of the habitat being destroyed. Much of the impacted wetlands would recover in 1-2 years.

As noted in Table IV-8 under the Base Case, the OSRA model indicates low chances (0.5%-1%) of a large spill occurring and contacting wetland areas in the WPA. Therefore, it is assumed that no large spills occurring as a result of Sale 125 would contact Texas wetlands. No spills of > 50 and < 1,000 bbls would contact the coastline, and only one spill of > 1 and ≤ 50 bbls is assumed to contact the coast during the 34 year lease life (Section IV.B.2.). Spills could occur from pipelines that traverse the marsh and carry OCS products, from shuttle tankers that are transporting crude oil to existing marine terminals, and from storage tanks that are located in wetland areas. Statistics for coastal spills are only available for large spills from shuttle tankers (Section IV.B.1.). According to these figures there is less than a 0.5% chance of the occurrence of such a spill. It is, therefore, assumed that a large spill will not occur and contact wetland areas in the WPA.

Small chronic spills less than or equal to 50 bbls, including those of 1 bbl and less, that occur as a result of the proposed action will add to the petroleum contamination that exists in the coastal waters of the WPA (Section IV.D.3.b.). As discussed above, however, it appears that low levels of oil in the marsh substrate and in plant tissues have caused only small disturbances or have actually resulted in growth stimulation of affected vegetation. Spills of 50 bbls or less are, therefore, not expected to result in deleterious impacts on the growth of *Spartina* and other wetland plants in the WPA.

No onshore OCS-related infrastructure construction is anticipated to result from the proposed action in the WPA (Table IV-2).

Conclusion

The level of impact on coastal wetlands in the WPA resulting from the proposed action is expected to be very low.

Cumulative Analysis

This cumulative analysis considers the effects of impact producing factors related to the proposed action plus those related to the Central Gulf proposed action, prior and future OCS sales, other governmental and private projects/activities, and pertinent natural processes and events that may occur and adversely affect wetlands in the same general area that may be affected by OCS oil and gas activity located in the WPA. Specific types of impact producing factors considered in the analysis include construction of onshore support and processing facilities, oil spills, sediment deprivation, submergence, canalization, land development, and miscellaneous factors.

The nonforested wetland habitat base, 537,012 acres, in the WPA is decreasing; however, no composite annual rate of decrease is available. In addition to the impacts described for the proposed action, Section IV.D.1.a.(1) has a further discussion of cumulative wetlands loss. Major factors affecting this loss are residential, urban and industrial development, submergence, and wave erosion (Shew et al., 1981). Development replaces the coastal wetlands with upland habitats. Submergence encourages saltwater intrusion and flooding of wetlands. Wave erosion replaces the nonforested emergent wetlands with open water.

Four new pipelines traversing 100 miles of coastal habitat are anticipated as a result of previous and future OCS leasing. Three new marine terminals are also anticipated. Backfilling the pipeline canals will effectively reduce direct and indirect impacts.

The effects of spilled oil on coastal wetlands has been discussed above in the Base Case Analysis section. Under the cumulative scenario, the probability of contact between spilled oil resulting from the proposed action, prior and future OCS leasing, and the tankering of imported oil and with wetlands will increase compared to the Base Case. As indicated in Table IV-8, the chance of one or more large spills occurring and contacting wetlands along the Western Gulf coast is 18% for the Central Texas marshes and 64% for the Eastern Texas marshes.

Sources of spilled oil other than those included in Table IV-8 include onshore pipeline leaks, spillage from tankers in estuaries, and spillage associated with onshore oil development. Statistics on shuttle tanker spills in estuaries indicate a 45%-98% chance of occurrence of a large spill from tankers approaching various Texas ports (Section IV.B.1.b.). Based on these percentages, it is reasonable to assume that small spills and one large spill will occur and contact wetlands at different sites.

Conclusion

The cumulative level of impact on coastal wetlands in the WPA is estimated to be moderate.

High Case Analysis

As noted in Table IV-8 for the High Case, the OSRA model indicates a reasonably low percent chance (1%-3%) of an oil spill(s) occurring and contacting wetland areas in the Western Gulf coastal area. The highest chance of contact for marshes is in the eastern coastal marshes of Texas (3%). It is also likely that one spill of > 50 and < 1,000 bbls and a few spills of > 1 and ≤ 50 bbls will contact the coastline sometime during the 34-year lease life. The extent of the impact to the resource has been discussed in the Base Case Analysis section for the occurrence of a small spill. The impacts of a small spill will be localized compared to the total area of wetlands in the WPA and will be short-lived (1-2 years). No new onshore facilities or pipeline landfalls are expected as a result of the High Case (Table IV-2).

Conclusion

The level of impact to wetlands for the High Case is expected to be low in Western Gulf coastal subareas.

(2) Impacts on Sensitive Offshore Habitats and Communities

(a) Deepwater Benthic Communities

The definitions used to describe the expected levels of impact to the deepwater benthic communities are discussed in Section IV.D.1.a.(2)(a) and listed in Table S-4.

Base Case Analysis

Impacts to deepwater (greater than 400 m) benthic communities (e.g., chemosynthetic communities) will occur as a result of continued OCS activities in the Western Gulf.

The greatest potential for adverse impacts to occur to such communities would come from those OCS related activities associated with pipelaying, anchoring and structure emplacement. These activities, which lead to localized bottom disturbances and disruption of benthic communities in the immediate area of the activity, would be minimal in regions of suspected high-density chemosynthetic communities. Considerable mechanical damage would be inflicted upon the bottom by routine OCS drilling activities. The drilling operation itself disturbs a small bottom area. The presence of a conventional structure can cause scouring of the surficial sediments (Caillouet et al., 1981) and it has been estimated that between 1-4 acres of bottom may be disturbed from platform emplacement activities alone. Anchors from support boats and ships (or more likely in these water depths, from any buoy set out to moor these vessels), floating drilling units, and pipelaying vessels also cause severe disturbance to small areas of the seafloor. The area affected will depend on the water depth, length of the chain, size of the anchor, and current. Anchoring will destroy those sessile organisms that are actually hit by the anchor or anchor chain during anchoring and weighing anchor operations. While such an area may be small in absolute terms, it may be large in relation to the area inhabited by chemosynthetic communities. Normal pipelaying activities in deepwater areas consist of laying the pipe along the seafloor. This in itself could highly impact communities such as Bush Hill, which are areas of high biomass; little is known at present of the size, number, or locations of these important communities, although it is known that they are associated with hydrocarbon seeps and gas- and/or oil-charged sediments. It is these areas that are most at risk from oil and gas operations. It is likely that pipelines will be used to transport product ashore from those deepwater areas in close proximity to the current pipeline network in both the Central and the Western Gulf. In the extreme deepwater provinces, shuttle tankering would substitute for pipeline as a means of transporting product, therefore impacts to these deepwater communities, from this type activity, would be precluded in the more isolated areas. As discussed in Section III, the majority of these benthic communities are of low diversity and widespread throughout the deepwater areas of the gulf and would tend to repopulate disturbed areas. The disturbance of the Bush Hill-type community, as identified in Section III, could lead to the destruction of the community, such that recovery would not occur. Due to the recent discovery of this type community, the vulnerability to impact, recoverability, and general extent of the community are unknown. However, a study is in progress that should add measurably to our body of knowledge of deepwater communities.

It is highly unlikely that discharges resulting from the proposed activities would impact the benthos in the water depths being discussed, due to the rapid dilution and dispersion of effluent components. In shallower depths, cuttings tend to form a low mound or be reworked into the surrounding sediments, depending upon the nature of the local sediments, depth of disposal, and physical forces acting upon the cuttings pile. Since they are discharged into very large volumes of water (the open Gulf of Mexico), they rapidly disperse, can be measured above background at only very short distances from the discharge point, and have little biological effect except very close to the discharge point.

NTL 88-11 became effective on February 1, 1989. The NTL formalizes the review process and makes mandatory the search and avoidance of "plush" chemosynthetic communities or the areas which, through interpretation of geophysical records, have a high potential for supporting these community types. The regions that have high potential for conditions that may support chemosynthetic communities, if not avoided initially, must be photodocumented and then re-evaluated. Avoidance of any regions with high-density chemosynthetic communities will still be required, although some regions may be "cleared" through this process.

However, a second issue, which has yet to be adequately addressed, is the potential impact to the organisms by the withdrawal of the hydrocarbons (the food source) from beneath the community. The seeps and vents around which these animals live are pressurized from the deep reservoirs that force the gas or oil to the seafloor. When all of the economically recoverable hydrocarbons from these reservoirs are withdrawn by production operations, it is possible that oil and gas venting or seepage would also stop. Current information does not allow a determination to be made as to whether this slackening of the pressure which drives the seeps would be reduced quickly (as they have been on land) or whether there may be enough oil already in the "conduit" to the surface to continue the seepage for long periods of time. Available information indicates that the driving force of the seeps may be water or oil and gas; it is not well known. Nonetheless, the issue of long-term impacts are poorly understood at this time. Long-term impacts to these communities from the withdrawal of oil and gas will most likely include a reduction in the amount of hydrocarbons available for metabolic processes. It should also be remembered that some of these communities derive energy from sulfide-rich environments and may not be impacted by reservoir depletion. However, the main question of the long-term impacts remains unanswered.

The probability of impact to a sensitive deepwater benthic community is expected to be low due to the small number of surface disturbing activities in deep water, the localized extent of the disturbance, and the apparently widely scattered and isolated nature of the sensitive communities. However, a Bush Hill-type community could be totally decimated if a drilling activity or anchoring took place right on top of it.

A Notice to Lessees (NTL) to detect and protect deepwater, high-density chemosynthetic communities has formalized the review and mitigating measures' procedures being performed by the MMS in water depths greater than 400 m and is discussed in Section II.A.1.c.(2). It is believed that this process serves to locate nearly all, if not all, the Bush Hill-type communities likely to be impacted by a specific operation. Adoption of NTL 88-11 results in the potential impact to the high-density chemosynthetic communites being reduced from very high to moderate because the effects of reservoir depletion on the chemosynthetic organisms are still undocumented.

Conclusion

The level of impact on the deepwater benthic communities of the Bush Hill type in the Western Gulf resulting from the proposed action is expected to be moderate because of implementation of the NTL. The impact to the widespread, low diversity areas is expected to be low.

Cumulative Analysis

Those cumulative factors considered to impact the deepwater benthic communities of the Western Gulf, include both oil- and gas-related and non-oil- and gas-related activities. The latter type of impacts include activities such as fishing, trawling, and anchoring. Oil- and gas-related activities include pipeline and platform emplacement activities and anchoring, which is expected to be much higher than under the Base Case. The analysis considers the effects of these factors related to the proposed action and prior and future OCS sales.

Due to the water depths being discussed, as for the proposed action, the greatest potential for adverse impacts to occur to the deepwater benthos stem from pipeline and platform emplacement and associated anchoring activities. The impacts to benthos are discussed above briefly. As exploration and development continues on the Federal OCS, activities in the Central and Western Gulf regions have moved into the deeper water areas of the Gulf of Mexico. With this trend comes the certainty that increased development will occur in these areas, accompanied by stress to the deepwater benthos from bottom disturbances and disruption of the seafloor from associated activities. The extent of this disturbance shall be determined by the intensity of development in these deepwater regions as well as the types of structures and mooring systems utilized.

Conclusion

The cumulative level of impact on the deepwater benthic communities of the Bush Hill type in the Western Gulf is expected to be moderate. The impact to the widespread low diversity areas is expected to be low because of existing operational restrictions imposed by NTL 88-11.

High Case Analysis

The deepwater benthic communities (e.g., chemosynthetic communities) would be subject to vey limited physical destruction from rig emplacement, platform and pipeline installation, and anchoring. As noted under the Base Case, it is highly unlikely that discharges from the proposed activities would adversely impact the benthos in the water depths (greater than 400 m) being discussed, due to the rapid dilution and dispersion of effluent components. Because the offshore infrastructure estimates (wells and platforms) are greater in this scenario, the possibility of an operation occurring on or near a sensitive deepwater benthic community, of the Bush Hill type, would be greater than for the Base Case. Therefore, the probability of an impact occurring would also be greater than for the Base Case. However, because of the scattered nature of the communities and the mitigating measures mandated by NTL 88-11, impacts are still low.

Conclusion

The level of impact on the deepwater benthic communities in the Western Gulf from the High Case to Bush Hill-type communities is expected to be moderate. The impact to the widespread, low diversity areas is expected to be low.

(b) Topographic Features

The potential impact producing factors on the topographic features of the Western Gulf are oil spills, blowouts, anchoring, structure emplacement, effluent discharge, and structure removal. See Table S-4 for definitions of the impact levels.

The description of the impacts to the topographic features of the Western Gulf is hereby incorporated by reference from Final EIS 113/115/116 (USDI, MMS, 1987b, pages IV-183 through IV-190) and from Final EIS 118/122 (USDI, MMS, 1988c, pages IV-150 through IV-152). Presented below is a summary of that material. Except for the OSRA numbers and the quantities of materials expected to be discharged into the Gulf as a result of this proposed action, the referenced analyses are valid for this proposed action.

Oil spills may occur at the surface due to tanker spillage and platform spills or at the seafloor due to pipeline rupture or well blowout. Both surface and subsurface spills could result in a steady discharge of oil over a long period of time.

Blowouts can occur from either oil or gas wells. Oil well blowouts may result in oil spills. Both gas and oil well blowouts result in large amounts of bottom sediment being thrown into the water column.

Anchoring of pipeline lay barges, drilling rigs, or work boats and structure emplacement (pipeline, drilling rig, or platform emplacement) result in physical disturbance of the benthic environment. These bottom-disturbing activities are the most likely to cause permanent or long-lasting impacts to sensitive offshore habitats.

Drilling muds and cuttings discharge results in localized water turbidity, deposition on the surrounding seafloor, and potential effects of the low concentrations of toxic constituents. Formation waters are routinely discharged during production operations.

Platform removal results in water turbidity, sediment deposition, and potential explosive shock wave impacts. The impact producing factors are discussed more thoroughly in Section IV.A.3.

Base Case Analysis

The topographic features of the Western Gulf providing sensitive offshore habitats are listed in Section III.B.2. Sensitive offshore habitats are most seriously affected by disturbance from the anchoring of service vessels and drill rigs and from the emplacement of structures such as rigs, platforms, and pipelines. Disturbance from such activities is likely to cause permanent or long-lasting impacts. Since topographic high communities tend to be located above salt domes, which are ideal oil and gas producing structures, disturbance could be expected to occur at each of these communities.

The resuspension of sediments disturbed during a subsurface blowout, and the settling of drilling muds and cuttings result in localized water turbidity and deposition of the materials on the surrounding seafloor, with additional potential harmful effects from concentrations of toxic constituents, which could cause the smothering of local benthic communities or induce stress in part or all of a local community. Again, the high probability that activity would take place on or near each of the topographic features means that each would likely be subjected to some stress from particulate or toxic materials.

There is an estimated 13% chance of an oil spill greater than or equal to 1,000 bbls occurring in the Western Gulf as a result of the proposed action (Base Case) (Table IV-5), and it is estimated that one small spill of > 1 and ≤ 50 bbls will occur each year and one spill of > 50 and < 1,000 bbls will occur during the 34-year lease life (Section IV.B.2.). No sensitive offshore habitats are likely to be contacted because the oil is unlikely to reach the depths of the habitats.

Removal of platforms constructed on or very near sensitive habitats (in the absence of the proposed stipulation of Section II.B.1.d.(1)), if carried out using current methods of explosive removal, would adversely affect benthic habitats very near the removal site. However, the relative small size of the charge and the fact that the charge is detonated 16 feet below the mudline would serve to restrict the impacts to very close to the structure being removed. See Section IV.A.3.j. of this EIS and especially Section IV.A.3.j. of Final EIS 118/122 (USDI, MMS, 1988c, pages IV-35 through IV-37) for more information regarding structure removals.

Conclusion

The proposed action is expected to have a very high impact on the sensitive offshore habitats of the topographic features.

Cumulative Analysis

Oil and gas leasing has been increasing around the topographic features of the Western Gulf, and this trend is expected to continue in the future. Of the 200 blocks in the WPA that are near the topographic features, 118 are under active lease (Appendix A). The impact from cumulative oil and gas routine operations includes the impacts from the operations conducted as a result of the proposed action, future OCS sales, past sales (which include the biological stipulation of Section II.B.1.d.(1)), and the tankering of imported oil.

Anchor damage and damage from structure emplacement are considered to be the most serious threats to coral and coral-community areas. The biological stipulation on the existing leases prohibits the anchoring of industry-related vessels and the emplacement of structures by the industry in the No Activity Zones; the stipulation does not affect other activities such as anchoring, fishing, or recreational SCUBA diving nor would it prohibit industry-related anchoring on leases as a result of the proposed action. No data are available on the extent to which such anchoring may take place; however, all three activities are known to occur in proximity to the topographic features.

Nearly all the banks are near the established shipping fairways. The banks are apparently well-known fishing areas. Several of the shallower cresting banks are SCUBA trips destinations. Anchoring at a topographic feature by a vessel involved in any of these activities would cause significant damage to the biota, although the degree of damage would depend on the size of the anchor and chain. There is potential for serious anchor damage to the biota of topographic features. Treasure hunters have destroyed large areas of Bright Bank by using explosives to blast through the coral reef. The impact has been high to Bright Bank as a result of this blasting activity.

Increased leasing near topographic features increases the probability that a blowout or seafloor oil spill may occur in proximity to a feature. There is an estimated 99+% chance of an oil spill greater than or equal to 1,000 bbls occurring in the Western Gulf as a result of the Cumulative Scenario (Table IV-5), and it is estimated that a few spills of > 1 and ≤ 50 bbls will occur each year and that several spills, but less than one per year, of > 50 and < 1,000 bbls will occur during the 34-year lease life (Section IV.B.2.). Such an occurrence could be catastrophic in the immediate vicinity of the blowout; however, the probability that the oil spill or suspended sediments would reach a bank is low. Therefore, no spill-related impacts are anticipated.

Impacts to the topographic features could occur as a result of operational discharges from import or shuttle tankers. There is a 99+% chance of a spill occurring due to the tankering of crude oil imports (Table IV-5). Due to the dilution factor and the depths of the banks, this activity is not expected to have a high level of impact on the topographic features.

Impacts from natural occurrences such as hurricanes are not expected to result in damage to the banks.

Conclusion

The level of cumulative impact to the sensitive habitats of the topographic features of the Western Gulf is estimated to be very high.

High Case Analysis

Higher oil and gas activity may be expected near the topographic features of the Western Gulf as a result of the High Case. The biota of the topographic features would be subject to physical destruction from rig emplacement, platform and pipeline installation, and anchoring. The biota would also exhibit effects ranging from short-term stress responses to mortality resulting from the discharges associated with drilling. Because the offshore infrastructure estimates (wells and platforms) are greater in the High Case, the possibility of an operation occurring on or near a sensitive offshore habitat would be greater than for the Base Case. There is an estimated 26% chance of an oil spill greater than or equal to 1,000 bbls occurring in the Central Gulf as a result of the High Case (Table IV-5), and it is estimated that a few spills of > 1 and ≤ 50 bbls will occur each year and that a few spills of > 50 and < 1,000 bbls will occur during the 34-year lease life (Section IV.B.2.). Therefore, the probability of an impact occurring would be greater than for the Base Case.

Conclusion

The level of impact to the sensitive habitats of the topographic features of the Western Gulf is estimated to be very high.

(3) Impacts on Water Quality

The nature of impacts on ambient water quality from routine discharges resulting from the proposed action will be the same as those generic impacts for the Central Gulf (Section IV.D.1.a.(3)), with major differences being primarily quantitative in nature. Definitions of impact levels are presented in Table S-4.

(a) Coastal/Nearshore

Coastal/nearshore water quality may be altered by a number of activities resulting from OCS oil and gas development, including routine point and nonpoint discharges from onshore support facilities, discharges from support vessel traffic while in the coastal area, canal dredging and pipeline emplacement actions, altered hydrology due to the presence of leveed canals and pipelines, and oil and chemical spills. The following discussion addresses each of these potential impacts to coastal water quality.

Although a problem in the Central Gulf of Mexico, coastal discharges of produced waters from OCS operations do not occur in Texas (Section IV.A.3.a.).

Base Case Analysis

Effects of Routine Point and Nonpoint Source Discharges

Routine discharges from onshore support facilities may impact local onshore water quality. A general discussion of these point and nonpoint source discharges and the types of contaminants discharged from support facilities are described in Section IV.A.3.a. It is anticipated that the current onshore infrastructure base in the Western Gulf is currently sufficient to support proposed Sale 125 and that no new infrastructure will be built (Table IV-1). No discharges, therefore, such as nonpoint source runoff, would occur from construction operations or from modifications of existing hydrologic conditions. Up to 12% of the existing infrastructure will be used to support the sale activities, and routine discharges from these facilities would enter the coastal waters. However, given the following three facts, it is expected that routine effluent discharges associated with this proposed sale would contribute only slightly to coastal water quality degradation: (1) point source discharges are limited by regulations of both Federal and State water pollution agencies; (2) discharges would be of such small quantities relative to the total number of anthropogenic discharges entering the affected waterbodies; and (3) the Texas estuarine system's water quality has improved since 1972 even though it has been exposed to similar inputs (Texas Water Commission, 1986).

Effects of Canals and Pipelines

Dredging of new canals to transport service vessels from shore-based facilities to OCS platforms, to provide general access to shore-based facilities, and for emplacement of pipelines results in sediment suspension, increased water column turbidity, and the possible release of contaminants, which were in the bottom sediments. A general discussion of the impacts resulting from dredging and pipeline emplacement operations is presented in Section IV.A.3.e. and f. Although no new pipelines or canals are projected to be built due to this proposed sale, the existing pipeline and canal network would be accessed to transport vessels, materials, and oil and gas ashore. Any maintenance dredging, which would deepen old channels, would result in saltwater intrusion impacts and degraded water quality. It is assumed that some of the existing canals would have to be dredged during the 34 years projected as the life of the proposed sale. Therefore, it is expected that there would be a very low impact from dredging activities associated with this proposed sale.

Effects of Accidental Spills

Oil spills can have significant long-term or acute impacts on the water quality of the areas affected. Impacts could result from oil spills occurring from OCS activities and reaching land or from spills occurring in coastal areas from shuttle tankering, service vessels, or OCS pipelines crossing coastal areas. Spills could also occur at refineries and tank farms, spilling both crude oil and a number of products, such as jet fuels, diesel fuel oil, and gasoline; or at marine terminals such as transshipment terminals, crude oil receiving terminals, or product terminals during offloading or onloading operations.

Once oil is spilled, a number of processes occur that alter the chemistry of the oil and modify its characteristics in water (Section IV.B.3.). The vast majority of the oil that would reach nearshore waters would be in the form of a slick floating on the surface of the water. Hopefully, offshore cleanup operations would have removed a majority of the oil from the sea surface. However, given the complexity of the factors affecting cleanup operations, at a minimum, it is assumed that 15% of the spill would have been cleaned up. Including this percentage as part of the percent reduction in the slick's volume, it is assumed that within 30 days 99% of the floating slick would have dissipated (Section IV.B.3.) (Table IV-10). About 1%-5% of the volume of the surface slick is predicted to dissolve in the water column. A larger percentage could be measured in the water column at any one time but would have a shorter residence time as the oil is absorbed onto particulate matter, deposited on the seafloor or taken up by organisms. The relative amount of oil that resides in the water column is a function of a number of factors, including the point of release (surface versus subsurface), the hydrographic conditions affecting the surface slick, and the amount of sedimentary material in the water. Given the above, it is projected that a large oil spill reaching coastal waters would alter the water quality of nearshore waters for a short time and that the oil would weather and would unlikely be detectable in significant quantities within 30 days after the spill occurs. The OSRA model indicates a very low percent chance (2%) (Table IV-8) of a large oil spill occurring and contacting land in the CPA. Given the above, it is expected that large oil spills occurring as a result of this proposed sale would not cause significant changes to the nearshore open water quality.

If the slick were to reach protected bays, wetland areas or areas behind barrier islands, the dissipative factors reducing its concentration in water would be slower due to the low energy of such areas and the thickness of the oil on the isolated water bodies. Oil that might coat the sediments and vegetation might be released over a longer time frame. Studies of spills occurring in the Louisiana and Texas wetlands have shown that the spills resulted in destruction of vegetation and resultant erosion, and in release of oil from contaminated sediments into overlying waters (Section IV.D.1.a.(1)(b)). When a dense oiling of the marsh surface occurred, significant effects were observed for over one year from the time of the spill. Based on these study conclusions, it is assumed that if a large spill would occur and result in heavy oiling of the surrounding marsh, very high impacts to water quality would occur from sediments released into the water column due to erosion processes and the transport of oiled overlying water within the spill site.

Small spills greater than 50 bbls could likely result in the same level of impact that is described above for large spills. The impacts may be of shorter duration and extent. However, the discussion found in Section IV.D.1.a.(1)(b) on studies examining the effects of oil spills on wetland habitats describes spill incidents within the size category of > 50 and < 1,000 bbls. These studies showed that it was the density of oiling as well as the size of the spill that determined the level of impact. Spills less than or equal to 50 bbls would not likely meet the criteria of heavy oiling and, therefore, would not likely cause any short-term deleterious water quality degradation. Such spills, including spills of 1 bbl and less, could contribute to long-term chronic water quality degradation. Chronic pollution is addressed below, separately.

Spill statistics for spills less than 1,000 bbls occurring offshore are discussed in Section IV.B.2. It is shown that no spills occurring offshore in the size category of > 50 and < 1,000 bbls would contact the coastline. The assumption for spills of > 1 and ≤ 50 bbls is that a very low percentage of these spills would occur in the OCS area in proximity to the WPA coastline.

The OSRA model indicates low percentages (less than 0.5%-1%) of a large oil spill occurring from offshore platforms, pipelines, or shuttle tankering operations and contacting bays and marsh areas (Table IV-8). The Galveston area has the highest percent chance of contact (1%). Large oil spills occurring from shuttle tankers while in the coastal area are presented in Section IV.B.2. The OSRA model indicates that there is less than a 0.5% chance for the occurrence of a large oil spill. Statistics on oil spills occurring from OCS activities in coastal waters, such as from pipelines that traverse the coastal marsh, are unavailable.

During the period of 1987 to June 1988, there were 466 oil and chemical spills in the Texas coastal county area (Texas Water Commission, 1988). Although documentation provided by Texas does not list the causes of these spills nor their size, it is expected that one spill occurred due to OCS support activities; however, it is unlikely that the spill incident was over 1,000 bbls.

Based on the above, it is assumed that no large spill will occur from onshore or offshore sources and impact inland coastal water quality. However, one spill in the size class of > 50 and < 1,000 bbls would occur from onshore sources.

Taking into account expected effects from oil spills interacting with coastal water quality and the probabilities of such an interaction described above, it is concluded that one small spill greater than 50 bbls will result in a very high impact to Texas water quality in a localized area.

In order to address the issue of chronic petroleum contamination of the Texas coastline, studies that analyzed Gulf coastal sediments and biota to determine if petroleum hydrocarbons are being concentrated were examined. The following study conclusions are extracted from the Texas A&M University (1988) *Second Annual Report of the NOAA Mussel Watch Program*, which addressed the current condition of the Gulf's water quality. Baseline studies in 1978-1979 at the brine disposal sites off the Louisiana and Upper Texas Coast detected the presence of petroleum hydrocarbons in water, biota, and sediments. The report concludes that the presence of the petroleum hydrocarbons is due to the influence of the Mississippi/Atchafalaya riverine inputs, petroleum operations, and transportation activities. In 1977, the USEPA Mussel Watch Program in 1977 showed that oysters in Gulf Coast areas near known inputs of petroleum hydrocarbons exhibited elevated concentrations of polynuclear aromatic hydrocarbons (PAH's) above those found in remote areas. Results of the recently completed NOAA Mussel Watch Program's Second Annual Report data analysis showed that 289 Gulf Coast oysters samples, used as indicators of water quality, were showing contamination with petroleum hydrocarbons. However, the total PAH concentrations measured in Gulf of Mexico oyster and sediment samples are generally lower than PAH concentrations at East and West U.S. coast locations, probably due to the fact that the sites in the Gulf are further removed from point sources. In summary, these studies have showed that (1) chronic petroleum contamination is taking place partially from oil and gas operations off the Gulf coastline, but (2) water quality degradation is not taking place to such an extent to show marked increases over U.S. coastal areas that do not have as much oil operations.

Effects of Support Vessel Traffic

Shuttle tankering will carry 56% of the oil produced ashore. It is estimated that 15 shuttle tanker trips from offshore facilities to shore-based terminals will occur during peak years of production. Other service vessels carrying personnel and supplies will make an estimated 3,141 trips to shore per peak year (Table IV-2). Water quality could be degraded by support vessel traffic primarily through introduction of petroleum hydrocarbons from accidental spillage, chronic discharges of oil and fuels, and the release of antifouling paints to surrounding waters. These discharges could occur in connection with the offloading of crude from shuttle tankering activities, fueling activities associated with supply boat support, and the discharge of bilge water. Supply boats also degrade water quality by discharging domestic and sanitary wastes and by throwing trash overboard. Tributyltin, a major component of many antifouling paints used on marine boats, vessels, and tankers, has been shown to have toxic effects on some marine biota. Tributyltin has recently been regulated to decrease the total amounts released into the environment from marine paints. Although expected to slow environmental loadings, some amounts will still be entering the marine environment. Monitoring programs will be established to determine how harmful these reduced quantities will be. Support vessel discharges affect the water quality along coastal navigation channels, at service bases located along the coast, and at highly populated, confined harbors and anchorages with a large amount of marine traffic. The impacts from chronic spillage and the release of antifouling paints are expected to be low in a few locations along the coast where there is a high amount of support vessel traffic, such as the Houston Ship Channel.

Conclusion

In conclusion, impacts from OCS oil and gas operations associated with Sale 125 on coastal water quality are expected to be low in a few locations along the coast due primarily to chronic oil spillage and antifouling substances released in areas that experience large amounts of support vessel traffic and shuttle tankering operations and very high in one localized area due to a small spill. The impacts are expected to be low.

Cumulative Analysis

The cumulative analysis considers the effects of routine or chronic accidental discharges, nonpoint source discharges such as surface runoff from land, hydrocarbon and chemical spill incidents, atmospheric fallout, rainout, and natural seepage entering the coastal waters of the WPA. These discharges could occur from the proposed action plus those related to past and future OCS oil and gas development activities, State oil and gas development activities, urban and agricultural expansion, municipal and industrial wastes, recreational and commercial boating, a multitude of marine transportation, and natural events. Section IV.A.2. presents information on major activities occurring in the Gulf.

The number of new onshore support facilities needed to aid all OCS oil and gas activities expected in the next 34 years includes 1 new service base, 4 new pipelines going ashore, 100 new miles of onshore pipeline, and 3 new marine terminals (Table IV-2). These facilities, added to the existing facility network (Table IV-2), would substantially increase the number of effluents expected to be discharged into coastal waters. Construction activities for the new service base and marine terminals would impact localized water quality in the short term (Sections IV.A.3.a., e., and f.).

State oil and gas activities are expected to continue to expand. The existing network of pipelines and the navigation channels supporting both the State and Federal oil and gas system would continue to cause sediment erosion, saltwater intrusion (due to new canals or redredging of existing canals), and restricted water movement and, therefore, water quality problems in coastal Texas.

Produced waters discharged from State oil and gas activities would be substantial and, unless regulated, could have a significant impact at some of the discharge sites. Total amounts of produced waters currently being discharged into Texas coastal waters are 735,854 bbls annually (Boesch et al., 1988). At least one site, the Nueces-

Rio Grande coastal basin, showed deteriorated water quality due to past brine discharges. Impacts from produced waters are discussed in Section IV.A.3.a.

Shuttle tankering will carry 47% of the oil produced ashore. It is estimated that 126 shuttle tanker trips from offshore facilities to shore-based terminals will occur during peak years of production. Other service vessels carrying personnel and supplies will make an estimated 17,888 trips to shore per peak year (Table IV-2).

As part of NOAA's Status and Trends Program (Texas A&M University, 1988), the water quality along the Gulf of Mexico was examined to determine the long-term temporal and spatial trends of contaminant concentrations in bays and estuaries. The following results are from Years I and II of sampling and from previous studies. Trace metals, PAH's, pesticides, and PCB's were analyzed in sediments and oysters. Sampling sites chosen were away from known point sources of contaminant input. The results of the study examining PAH's is presented above in the preceding impact analysis. The following discussion summarizes the remaining report. For the most part, Texas did not exhibit high concentrations of chlorinated hydrocarbons, with the exception of a few "hot spots." Moderately elevated concentrations of pesticides and PCB were measured in sediments in Matagorda Bay and Galveston Bay, Texas. Trace metal concentrations showed a great deal of variability. Previous studies found cadmium contamination in Corpus Christi Bay and Houston Ship Channel sediments. Results of the NOAA study found silver concentrations very high in oysters at Copano Bay and Sabine Lake (Year I only). Sabine Lake also exhibited high concentrations of zinc in the first year of sampling. Coprostanol, a chemical representing human or animal waste, was detected in all sites sampled. In particular, tributyltin was measured in bivalves to determine the extent of contamination in the Gulf of Mexico. Tributyltin is a major component of many antifouling paints used on marine boats, vessels, and tankers. Tributyltin has recently been regulated to decrease the total amounts released into the environment from marine paints. Although expected to slow environmental loadings, some amounts will still be entering the marine environment. Monitoring programs will be established to determine how harmful these reduced quantities will be. Only recently has it been studied a new potential environmental contaminant because of its toxicity to marine organisms. Oysters and mussels sampled were in most instances contaminated with tributyltin and its derivatives. The results of this study certainly show that regional water quality is being contaminated with some pollutants. The latest Texas Water Commission (1986), however, finds that the estuarine and ocean water quality along its coast has improved substantially since 1972. The designated uses of Texas coastal water quality have improved 40.5% and 97.8% of the coastal waters support current designated water activity uses. Pollutant sources identified by the inventory were 23.9% industrial, 23.1% municipal, and the remaining unknown.

Section IV.A.2. presents a discussion of the major sources of oil contamination in the Gulf. Large spills from import tankering represent the greatest threat to coastal water quality from offshore large oil spillage incidents. There is greater than an 89% probability of one or more large spills occurring from import tankers while at sea and contacting land (mean number of spills is 2.2) (Table IV-8). Large spills from OCS development occurring due to past sales, Sales 123 and 125, and all future OCS sales, plus import tankering operations, increase the probability that at least one large spill would contact land to greater than 99% (mean number 5.5) (Table IV-8). Large spills from import tankers while in the coastal areas present a greater threat. There is up to a 98% probability of one or more large spills occurring from import tankers while near a port. The mean estimated number of occurrences for WPA port areas is 8.1 large spills. Small spills from OCS operations of > 1 and ≤ 50 bbls and one barrel and less contribute a small but continuous, chronic level of oil to the coastal waters (Section IV.B.2.). For a discussion of the extent of chronic petroleum contamination presently existing in the Gulf Coast area, see the previous impact analysis. Although not as significant as in the Central Gulf coastal waters, the Mississippi River carries a tremendous load of hydrocarbons, distributing them along the entire Central and Western Gulf Coast. The plume also contains high amounts of sediments and organic chemicals, trace metals, and pesticides that interact with the coastal and nearshore waters of Louisiana and Texas.

Conclusion

The level of impact on coastal/nearshore water quality from all significant causes of contamination is estimated to be moderate based on general levels of contamination expected to exist regionally along the coast. This is primarily due to industrial and municipal runoff, boating, and marine activities.

High Case Analysis

No further expansions of onshore support facilities are expected due to the increased amount of oil found. As noted in Table IV-8 under the High Case, the OSRA model indicates a 5% chance of a large oil spill occurring and contacting sheltered waters (bays and marshes) in the WPA. The assumed number of small spills was approximately double. Support vessel traffic and shuttle tankering also doubles, increasing to 32 and 5,242 trips per year, respectively. Effects from vessel traffic are described under the Base Case. However, it is not expected that this increase will affect a significantly larger area of the coastal waters.

Conclusion

The impact to coastal/nearshore water quality is expected to be low, mainly due to the effects occurring form chronic discharges from vessel traffic.

(b) Offshore

The description of the impacts to water quality in the Western Gulf is hereby incorporated by reference from Final EIS 118/122 (USDI, MMS, 1988c, pages IV-154 through IV-156). Presented below is a summary of that material.

Base Case Analysis

Impacts to offshore water quality will occur as a result of increased OCS activities in the Western Gulf. Those impact producing factors that may degrade offshore water quality are listed under Section IV.D.1.a.(3) for the Central Gulf and described in detail in Section IV.A.3.

Under the proposed Base Case, the discharge of up to 870 million bbls of formation/produced waters, 1.91 million bbls of drilling muds, 0.21 million yds^3 of drill cuttings, and an average of 84,000 gallons/day of treated sanitary and domestic wastes from platforms may be expected (Table IV-2). Pipeline-related activities would result in the disturbance of up to 0.60 million yds3 of sediment under the same scenario.

Dilution of discharges is extremely rapid in offshore waters to the extent that every substance measured in the water column, including turbidity, is at background by a distance of 1,000-2,000 m. For a more detailed discussion of drilling fluid/cutting discharges on the marine environment, see Section IV.A.3.a. The major effect is that of smothering, which is limited to within 300 m of the discharge point. Turbidity and toxicity are considered to be of minor consideration.

Table IV-5 indicates a 13% chance for one or more large oil spills (1,000 bbls or greater) from all OCS sources occurring in the Western Gulf as a result of the Base Case; thus, it is assumed that a large spill will not adversely affect offshore water quality. Furthermore, it is estimated that one small spill of > 1 and ≤ 50 bbls will occur each year and that one spill between 50 and 1,000 bbls will occur during the 34-year lease life (Section IV.B.2.). Petroleum hydrocarbons introduced into marine waters as a result of a spill may have some effects on local water quality, depending on weathering and the local physical and meteorological parameters. As discussed in Section IV.B.3., normal weathering processes encountered with oil spilled into open water conditions tend to render the spilled oil less harmful by breaking down many of the toxic components of the oil.

Contaminants from shuttle tankering activities may enter the Gulf as a result of routine operational discharges or as a result of accidental spills. Of prime concern would be problems related to the movement of crude oil and offshore loading practices, where the potential exists for accidental spills to occur. Of the total 13% chance, 5% is estimated to be due to shuttle tankering operations.

Immediate effects would be brought on by increased drilling, construction, and pipelaying activities, causing an increase in water column turbidities of the affected waters.

The discharge of an average of 84,000 gallons per day treated sanitary wastes from rigs and platforms will increase levels of suspended solids, nutrients, chlorine, and biological oxygen demand (BOD) in a small area near the point of discharge, which are quickly diluted.

Produced water is by far the largest quantity of waste to be discharged during normal oil and gas operations. The majority of these waters will be discharged directly to the surface waters surrounding the individual platforms. Some degradation (change) of the water quality will occur in the immediate vicinity of such discharges. However, these charges are not measured at distances greater than 1,000 m from the discharge, and no impacts on biota have been documented due to produced water discharges.

In addition, the natural condition of seawater may be altered in several ways during structure removal activities. These include the resuspension of bottom sediments, the discharge of solids and liquids generated by removal and transportation operations, and the generation of explosion by-products. These are discussed in Section IV.A.3.j.

Overall, offshore water quality degradation will occur within the immediate vicinity of exploration and production sites with high impacts expected to occur within a few meters to tens of meters from the discharge source. These impacts, however, will decrease to very low with distance (500-1,000 m) from the source.

Conclusion

As a result of the proposed action, the impact to offshore water quality in the Western Gulf is expected to be low.

Cumulative Analysis

The cumulative impact producing factors include those related to the proposed action plus those related to the Central Gulf proposed action, prior OCS sales, future OCS sales, State oil and gas activity, tankering and other vessel traffic, and industrial waste disposal activities that may occur and adversely affect offshore water quality in the same general area that may be affected by OCS oil and gas activity located in the WPA. Specific types of impact producing factors considered include well drilling discharges, pipeline emplacement, produced water discharges, dredging, accidental oil spillage, routine operational discharges, ocean disposal of hazardous material, and industrial waste discharges. A discussion of the non-OCS activities may be found in Section IV.A.2.

Under the cumulative scenario, the discharge of up to 13.43 billion bbls of formation waters, 24.52 million bbls of drilling muds, 2.75 million yds^3 of drill cuttings, and an average of 798,000 gallons/day of treated sanitary and domestic wastes from platforms (Table IV-2). Pipeline-related activities could result in the disturbance of up to 13.83 million yds^3 of sediment. Offshore waters will therefore be subject to cumulative impacts from discharges of drilling fluids, formation waters, and other effluents which add burden of both toxic and nontoxic materials to the water column. However, the natural processes of dispersion, degradation, and sedimentation will result in immeasurably low concentrations of these materials within a few meters to a few kilometers of the discharge site, resulting in low regional impacts.

Under this scenario, there is a 99+% chance for one or more large oil spills (1,000 bbls or greater) occurring in the Western Gulf, based on the OSRA (Table IV-5). Based on the high percent chance of a large spill occurring, it is assumed that there will be at least one spill that will, in fact, affect offshore water quality. Such a spill will impact more than a small local area near the source of the spill; in addition, the effects of the spill (higher than normal hydrocarbon and trace metal levels in the water column) are likely to persist for serveral weeks. Furthermore, it is estimated that a few spills of > 1 and ≤ 50 bbls will occur each year and that several spills of > 50 and < 1,000 bbls will occur during the 34-year lease life (Section IV.B.2.). For a discussion on the fate of spilled oil, see Section IV.B.3.

Another concern relates to the movement of crude oil and offshore loading practices, where the potential exists for spills to occur.

Conclusion

The level of cumulative impact on offshore water quality due to the high probability of a large oil spill, is estimated to be moderate.

High Case Analysis

Under the High Case, the discharge of up to 1.91 billion bbls of formation/produced waters, 3.50 million bbls of drilling muds, 0.39 million yds^3 of drill cuttings, and an average of 168,000 gal/day of treated sanitary and domestic wastes from platforms may be expected (Table IV-2). Pipeline-related activities would result in the disturbance of up to 1.2 million yds^3 of sediment.

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Offshore waters will be subject to impacts from discharges of drilling fluids, produced waters, and other effluents which add burdens of both toxic and nontoxic material to the water column. These quantities are much higher than those estimated for the Base Case; however, the natural processes of dispersion, degradation, and sedimentation will result in immeasurably low concentrations of these materials within a few meters to a few kilometers of the discharge sites, resulting in moderate impacts.

Under the High Case, there is a 26% chance of one or more large oil spills (1,000 bbls or greater) occurring in the Western Gulf, based on the OSRA (Table IV-5); thus, it is assumed that such a spill will, in fact, affect offshore water quality. Furthermore, it is estimated that a few spills of > 1 and ≤ 50 bbls will occur each year and that a few spills of > 50 and < 1,000 bbls will occur during the 34-year lease life (Section IV.B.2.). For a discussion on the fate of spilled oil, see Section IV.B.3.

As noted previously, contaminants from shuttle tankering activities may enter the Gulf as a result of routine operational discharges or accidental spills. Primary concern relates to the movement of crude oil and offshore loading practices, where the potential exists for accidental spills to occur.

Conclusion

The impact to offshore water quality is expected to be low.

(4) Impacts on Air Quality

For a generic discussion of impacts on air quality, see Section IV.D.1.a.(4). Definitions of impact levels are presented in Table S-4.

Base Case Analysis

The analysis of the impact of OCS activities on air quality relies to a large extent on the regulatory framework established by the Clean Air Act, as amended (P.L. 95-11). This Act is designed to protect the public health of individuals and the welfare of the natural environemnt as it pertains to air resources. Title I of this Act sets forth air quality standards for human health (primary standards) and for the welfare of the natural environment (secondary standards). Primary standards are for the protection of the physical well being of people and secondary standards are for the protection of the natural environment, which includes plants and animals. Reference to NAAQS in this document includes both primary and secondary standards.

The ambient onshore air quality in the WPA is generally better than the national standards, with the exceptions designated as nonattainment areas. Air quality conditions in the WPA have improved to the extent that Nueces County, Texas, has been redesignated (1987) as attainment for ozone. There are no PSD Class I areas in the Western Gulf. All nonattainment areas in the WPA are identified below:

Cameron, Texas
Nonattainment - Primary - TSP
Nueces, Texas
Nonattainment - Primary - TSP
Galveston, Texas
Nonattainment -Primary - O_3
Jefferson, Texas
Nonattainment - Primary - O_3
Brazoria, Texas
Nonattainment - Primary - O_3
Harris, Texas
Nonattainment - Primary - O_3 and TSP

Onshore, it is expected that no new refineries and no new gas processing plants in the Western Gulf will be needed. Offshore, 200 exploration and delineation wells, 210 development wells and 20 additional platforms will be utilized (Table IV-2).

Offloading of crude oil transported by surface vessel (on the Gulf of Mexico almost exclusively by barge) at coastal ports currently includes less than 3% of OCS production. Measured fugitive emissions from offloading operations are unknown, but the amount of hydrocarbons emitted is considered negligible (Von Bodungen, 1989) in the WPA. Safeguards to ensure minimal emissions from offloading and loading operations have been adopted (Marine Vapors Control Regulation, 1988) by the Louisiana DEQ. Projected deepwater OCS production would indicate that a substantial increase in barging is likely. Current industry practice based on economic considerations is to extend pipelines to new production when feasible. Barging new production to the nearest pipeline-equipped platform (if not available, then the nearest coastal terminal) is required until the pipeline network is expanded. Engine emissions from tug boats and other service vessels are created by these power boats. These emissions are temporary, mobile, and random in time and space. They are assumed to produce a negligible effect on air quality.

Catastrophic events, such as oil blowouts, are not possible to predict in time and location and have the potential to create localized air quality problems. Effects from these nonroutine activities are highly dependent on the distance offshore and the proximity to a nonattainment or PSD area. Higher impacts will occur if these events affect nonattainment or PSD Class I areas. Off Texas, the Federal OCS is over 10 miles from shore. It is estimated that approximately 45% of a spill can be lost due to evaporative losses during the first 10 days. In the Western Gulf, there is a 2% chance of one or more large oil spills (1,000 bbls or greater) that could occur and contact land as a result of the proposed action. The estimated mean number is less than 0.05 spills (Table IV-8). Significant degradation of onshore air quality is not expected due to oil spills.

In an attempt to estimate the amount of operational emissions produced as a result of Sale 125 for a year of activity, air emissions data were compiled for exploratory drilling and platform operations. Typical emissions for exploratory drilling are shown in Table IV-15 and are based on studies conducted by USEPA for offshore activities. Emissions for a major platform operations are presented in Table IV-16 and are based on data compiled from the 1987 air emissions inventory in the Gulf of Mexico.

Table IV-22 displays air emissions estimates under the proposed action using Base Scenario assumptions. An average annual figure is given for each activity and pollutant along with a total average for the proposed action. Computing the average requires estimating emissions for all operational activities. This allows for an accounting of emissions for both drilling and production. It is recognized that all activities do not occur at the same time. Drilling work is predominant in the early phases of exploration and development, while platform production expands gradually throughout the operating period. As production activity increases, drilling activity decreases. It should be noted that the total emissions estimated in Table IV-22 are based on values provided in Tables IV-15 and IV-16 and are not based on a detailed inventory of located emissions.

Table IV-22

Average Annual Air Emissions under Base Case Assumptions
Western Planning Area
(tons/year)

	NO_x	CO	SO_x	VOC	TSP	Number of Wells/ Platforms	Operations Period in Years
Proposed Action							
Exploratory Drilling	187.3	27.5	12.6	6.2	-	200	11
Development/Production Drilling	80.1	11.7	5.8	2.6	-	210[1]	27
Platforms[2]	1,715.0	223.4	3.0	650.0	4.2	20	
Total	1,982.4	262.6	21.4	658.8	4.2		

[1] Excludes subsea completions.

[2] Assumes all platforms are major platforms capable of producing emissions.

Source: Table IV-2.

It is projected that 20 platforms may result from this proposed sale. The platforms will be distributed throughout the WPA and will tend to be located farther offshore than existing platform locations due to trends in resource discovery locations. The effect of emissions from these platforms on air quality is assumed to be negligible. This assumption is based on recent modeling of emissions from 195 point sources nearshore in the CPA. This modeling study is described in the cumulative analysis of impacts on air quality from Sale 123. The result of this study is shown in Table IV-20 and is drawn from a study area with closely-pacted platforms close to shore. It is inferred that emissions from the 20 widely dispersed platforms in the WPA resulting from proposed Sale 125 will be no greater than those modeled. Use of the OCD Model for the projected 20 new platforms is not possible due to limitations of the model program and to the meteorological data requirements of the program.

The OCS emissions resulting from the proposed action cannot be measured with available information. The spatial distribution of rigs and platforms, the temporal distribution over time, and the specific equipment producing emissions are unknown. However, it is assumed the proposed action will distribute offshore activity throughout the area. Subplanning area W-2 has the least projected activity. Subplanning area W-1 has the next highest expected activity offshore and is located adjacent to land areas. Subplanning area W-3 is projected to have the highest level of activity. This area is a significant distance from, and does not adjoin any coastal shore. Emission controls or offsets are not expected to be necessary for onshore facilities.

Of the coastal counties adjacent to offshore areas where the majority of development will occur, the ones most likely to be adversely impacted by this activity due to their unique status as nonattainment areas are Cameron, Nueces, Galveston, Harris, Jefferson, and Brazoria Counties, Texas. There are no PSD Class I areas in the WPA.

The expected level of offshore activities adjacent to the above counties is low. Due to the low level of expected activity resulting from this proposed action, the impacts from operational emissions should be low.

Additionally, no significant degradation of onshore air quality is expected from routine offshore operational emissions due to the regulatory control provided in 30 CFR 250.44-.46. These regulations limit emissions from OCS facilities relative to significant levels outlined in Tables IV-13 and IV-14. The regulations require that individual analysis of emissions produced by proposed structures in the Gulf of Mexico be performed. Since 1980 this analysis has shown that no structure proposed to date will exceed the exemption level. These regulations insure that impacts do not rise above an upper level (moderate) and will be considered less than significant. Impacts are controlled by regulation in this case such that public health and welfare are protected at an acceptable level. Ozone (O_3) is not directly emitted from any OCS source. Impacts from uncontrolled events could be higher. The expected duration of impacts and a summary of expected impacts on the resource or concern are presented in Table IV-23.

Conclusion

The impact on coastal air quality from the proposed action is estimated to be low to moderate in any nearby coastal area where an uncontrolled blowout occurred. Low impacts are expected in Cameron, Nueces, Galveston, Jefferson, and Brazoria Counties, Texas. Very low impacts are expected throughout the remainder of the coastal area of the Western Gulf.

Cumulative Analysis

This cumulative analysis considers the effects of impact producing factors related to the proposed action plus those related to prior OCS sales, future OCS sales, State oil and gas activity, power generation, industrial activity, waste incineration, petrochemical processing and storage, vehicular and waterborne transportation, and other activities that may occur and adversely affect air quality in the same general area that may be affected by OCS oil and gas activity located in the WPA. Impact producing factors considered in the analysis are the routine emissions (point source and mobile) related to the above activities.

Point source emissions from onshore activities, such as non-OCS oil and gas processing, power generation facilities, industrial processing or manufacturing facilities, waste incineration facilities, petrochemical storage facilities and mobile emissions sources (automobiles, waterborne transportation, etc.), are expected to increase at rates in proportion to the growth of population. Energy conservation, improved automobile emission controls, alternative (non-fossil fuels) energy generation facilities, and new waste disposal technology are factors that will determine the rate of change in air quality. Regional population increases have occurred at a decreasing rate since 1970. Due to a decreasing population, in-migration throughout the Gulf region is noted. This fact supports the asusmption that ambient air quality is not expected to degrade beyond attainment standards where it is currently better than those standards or where PSD areas are located. The effects of all emissions on areas presently classified as nonattainment will be reduced over time so that attainment standards will be met. Controls or offsets may be applied to emission sources to meet these standards.

A study of the cumulative effects of offshore operational emissions produced by OCS oil and gas activities was undertaken. A description of the results of this study is in Section IV.D.1.a.(4). It is reasonable to assume that

Table IV-23

Summary of Expected Impacts on Air Quality-Proposed Action
Western Planning Area

Major Impact Producing Factor	Expected Impacts Onshore	Duration of Expected Impacts
Offshore Activity		
Catastrophic Events		
Blowouts with fire	Very low to moderate	Short-term
Oil spills (major)	Very low to moderate	Short-term
Release of sour gas (nonflared blowout)	Very low to moderate	Short-term
Operational Emissions*		
Exploration drilling	Very low	Long-term
Platform installation	Very low	Long-term
Development drilling	Very low	Long-term
Oil production	Very low	Long-term
Gas production	Very low	Long-term
Barging	Very low	
Onshore Activity		
Operational Emissions*		
Refineries	No new expected	Long-term
Gas processing plants	No new expected	Long-term
Offloading	Very low	Long-term

*Impacts from these activities are maintained below an upper limit (moderate) due to standing regulatory controls.

Note: Specific changes in conditions relative to levels of impacts are defined at the beginning of this section. Short-term is less than one year. Long-term is more than one year.

Texas offshore areas of the Gulf of Mexico with less concentrated activity and greater distance to shore would produce no greater air quality impacts than those described in the study areas.

The estimated aggregate OCS offshore emissions under the cumulative scenario are presented in Table IV-24. Estimates are included for emissions of NO_x, CO, SO_x, VOC, and TSP which would be generated by exploratory and development well drilling and routine platform operations. Existing platform distances to shore may range from 10 to over 150 miles. Emissions from OCS installations are calculated at the time of permitting production facilities. Such factors as the distance to shore, climatological conditions, and emission producing equipment on each platform are analyzed as to their contribution to the degradation of air quality. Since records have been kept (June 1980), this air quality permitting analysis has identified on an individual platform basis a negligible contribution to air quality degradation from new platforms.

Table IV-24

Cumulative OCS Offshore Air Emission Estimates
Western Planning Area

	Pollutant/Emissions (1,000 tons)					Number of
Offshore Infrastructure	NO_x	CO	SO_x	VOC	TSP	Wells/Platforms[1]
Estimated to be Developed						
Exploratory Wells Drilled	26.8	3.9	1.8	0.9	-	2,600
Development Wells Drilled	27.3	4.0	1.8	0.9	-	2,650
Subtotal	54.1	7.9	3.6	1.8		
Average Annual[2]	1.6	0.2	0.1	0.1		
Platforms						
Estimated to be Developed	16.3	2.1	0.1	6.2	0.0	190
Existing	14.6	1.9	0.1	5.5	0.0	170
Total Average Annual	32.5	4.2	0.3	11.8	0.0	

[1] The numbers of wells/platforms are taken from Table IV-2; except the number for existing platforms, which was derived by using only the number of platforms producing air emissions. Subsea completions are excluded.
[2] Based on a 34-year operating period.

No new oil refineries or new gas processing plants are projected for the WPA (Table IV-2). It is assumed that new source performance standards and best available control technology will be utilized on all facilities and that additional controls or offsets may be required in some areas to meet air quality standards imposed by existing regulations. It can be assumed that impacts will be their highest in the following counties which are classified as nonattainment areas: Cameron, Nueces, Harris, Galveston, Jefferson, and Brazoria Counties, Texas.

It should be noted that these identified nonattainment areas are classed as such for specific pollutants (TSP and O_3). Gas processing produces specific SO_x emissions only. Therefore, these activities will not be a significant threat to the identified counties except that these activities may use a substantial increment of the allowable SO_3 limit.

Conclusion

The level of cumulative impact on air quality is estimated to be moderate.

High Case Analysis

It is expected that up to 300 exploratory and delineation wells, 440 development/production wells, and 40 platforms will be utilized, along with no additional gas processing plants and no additional refineries. This compares to 200 exploratory and delineation wells, 210 development wells, 20 platforms, no gas processing plants, and no refineries in the Base Case (Table IV-2). New activity is expected to be almost evenly distributed throughout the WPA with subplanning area W-2 having the most expected activity. Impacts are similar in type and only slightly greater in magnitude than those described for the proposal.

Conclusion

The impact on coastal air quality is expected to be low to moderate in any nearby coastal area where an uncontrolled blowout occurs. Low impacts are expected in Cameron, Nueces, Galveston, Jefferson, and Brazoria Counties in Texas. Very low impacts are expected throughout the remainder of the coastal area of the Western Gulf.

(5) Impacts on Endangered and Threatened Species

Definitions of impact levels are presented in Table S-4.

In accordance with Section 7(a)(c) of the Endangered Species Act of 1973, as amended, consultations on the proposed Gulf of Mexico OCS lease sales were initiated with FWS and NMFS in December 1988. The FWS biological opinion for proposed OCS Lease Sale 125 (Western Gulf) determined this proposed action does not represent a substantive modification of the proposed action considered in an earlier biological opinion (June 30, 1982; USDI, MMS, 1984d). The earlier biological opinion concluded that the direct and indirect proposed actions are unlikely to jeopardize the continued existence of the species considered in the biological opinion or to result in the destruction or adverse modification of their critical habitats.

The NMFS biological opinion for proposed Sale 125 is pending. Communications with NMFS (Henwood, 1988, personal communication) indicate the biological opinion for proposed Sale 125 will be similar to the previous biological opinion for Sale 115 with a similar conclusion and will reference the previous biological opinion. The previous NMFS biological opinion (Appendix B) addressed all phases of OCS oil/gas activities that have occurred or are proposed in the Gulf of Mexico. The NMFS concluded that the proposed action is unlikely to jeopardize the continued existence of any endangered or threatened species under their jurisdiction.

Section 9 of the Act prohibits the "taking" of any endangered fish or wildlife (to "take" means harass, harm, pursue, hunt, shoot, kill, trap, capture or collect, or attempt to engage in any such activity). The incidental taking (accidental unavoidable taking) of an endangered species is discussed under Section 7(b)(4)(B) of the 1982 amendments to the Endangered Species Act. This section allows for the issuance of an "incidental take statement" along with a biological opinion. This "incidental take statement" operates to exempt the Federal agency and any permit or license applicant involved from Section 9 "taking" prohibitions under the Act if the subsequent implementation of the action is consistent with the terms and conditions of the incidental take statement (Appendix B).

Of the endangered and threatened species discussed in Section III.B.3., the brown pelican and sea turtles (green, Kemp's ridley, and loggerhead turtles) are probably the species most vulnerable to OCS-related oil/gas impacts resulting from this proposed action. The following analysis also represents possible adverse impacts to other protected species.

(a) Brown Pelicans

Base Case Analysis

Normal activities and accidental events associated with OCS oil and gas development may have impacts on brown pelicans. These include acoustic and displacement disturbances, explosive concussion, contact with noxious chemicals, and collisions. Impact by entanglement or ingestion of debris and displacement disturbances of oil spillage [illegible] have the greatest potential for impacting brown pelican populations.

Noise and disturbances associated with the use of explosives, seismic exploration, and platform operations are unlikely to significantly affect brown pelicans because they occur away from the pelican's coastal habitat. However, the concussive effect of seismic exploration and structure removal explosions may cause mortality of fish utilized by pelicans (Wingert, 1988). The dieoffs would be localized and short-term in areas not frequented by pelicans. The noise and disturbance associated with onshore support facilities, airborne and waterborne traffic, and pipeline construction have a greater potential for impacting pelicans than other OCS oil and gas activities because they occur in pelican habitat. No new onshore construction of this nature is planned by the proposed action. Offshore pipeline construction may cause resuspension of toxic chemicals during pipelaying. The toxins could be concentrated through the food chain, ultimately causing egg shell softening and deformities to pelicans. Such hazards are unlikely because of the minor disturbance to the sediments during installation. Noise and disturbances associated with vessel and flight traffic supporting offshore structures and with shuttling OCS-produced oil to port could cause abandonment of nests, excessive energy expenditures, and displacement to less suitable habitats. The proposed action has an estimated 16 shuttle tanker trips, 3,141 support vessel trips, and 5,658 helicopter trips during the peak activity year (Table IV-2). This represents a negligible amount of the total annual air and water traffic in the Gulf of Mexico. Though the rookery in Corpus Christi Bay is within the flight path and adjacent navigation channels, the proposed action is not expected to introduce or measurably elevate any existing impacts. Helicopter and vessel traffic also have the potential of colliding with brown pelicans. Though such events are rare, there is at least one documented report of an MMS inspection helicopter colliding with and killing a brown pelican.

Another potential hazard is the death or injury of pelicans from entanglement in plastic debris originating from OCS oil and gas platforms or support vessels. Pelicans may be particularly vulnerable to entanglement because their diving for food may be in areas where their prey seek shelter in debris (Centaur Associates, Inc. and Center for Environmental Education, 1986; Day et al., 1985). The MMS prohibits the disposal of equipment, containers, or other materials into offshore waters by lessees and contractors (30 CFR 250.90). In addition, Public Law 100-200 (101 Statute 1458) MARPOL, Annex V, which prohibits the disposal of any plastics at sea or in coastal waters, will go into effect January 1, 1989. Entanglement does not occur frequently enough to limit the regional population.

The discharge of drilling mud, cuttings, and produced waters could have an indirect impact on pelicans by adversely affecting their prey. Such impacts are likely to be short term and localized in areas not frequented by pelicans.

Spilled oil can impact brown pelicans by physical impairment, contact with toxics, habitat destruction, food contamination, and disturbances from oil spill response and cleanup efforts. The MMS (USDI, MMS, 1987b) and NAS (1985) provide a detailed discussion of each of these impacts. The brown pelican appears particularly vulnerable to oil spill impacts because of its small population and limited distribution in the Western and Central Gulf, tendency to congregate while feeding and roosting, time spent on the water, feeding behavior that entails diving into the water, and attraction to spills by the presence of asphyxiated fish on the surface. The ultimate impact and recovery of an oiled pelican depends on the physical and chemical composition of the oil, ambient conditions, and the state of the bird. It is assumed that freshly spilled oil contacting eggs, fledglings, and elderly or unhealthy birds for an extended period in cold, inclement weather is the worst scenario. Oiling can result in a bird's inability to fly, seek food, and thermoregulate. Inhalation of volatile components, though unlikely, could result in respiratory injury and asphyxiation. Ingestion by preening or consumption of contaminated fish may result in illness or reproductive failure.

Other previously mentioned impacts may also compound the effects of oiling. Observations of brown pelicans during the Puerto Rico and Apex Houston spills off the California coast where less than 1% of the local population were observed with oiled plumage, suggesting that they exhibit an avoidance reaction (USDI, MMS, 1987c). Oil spillage, as an indirect effect on pelicans by contaminating their food consumption of contaminated fish, could have a high local mortality, but this is unlikely to significantly reduce the regional population. Based on the OSRA model, it is likely that if a large oil spill occurred it would not contact the Corpus Christi pelican rookery. Oil spillage of less than 1,000 bbls per incident are likely to occur as a result of the proposed action. It is assumed that there will be one spill per year for spills of > 1 and ≤ 50 bbls and one spill per 34 years for spills of > 50 and < 1,000 bbls. A spill incident of > 1 and ≤ 50 bbls is assumed to contact the coastline sometime during the 34-year lease life, while no spills of > 50 and < 1,000 bbls were to contact the coastline during the lease life. The impacts of smalls spills are similar to those discussed for large spills. Small spills may have greater sublethal and long-term impacts on fecundity because of their chronic nature (Deiter, 1977). However, small spills are less likely than large spills to contact the coastal areas frequented by pelicans. Based on the apparent avoidance of oil spills by brown pelicans, the unlikely contact of pelicans with spilled oil, marine debris, and disturbances from most OCS activities, any resultant population decline would not last more than one generation.

Conclusion

The impact to brown pelicans is estimated to be low.

Cumulative Analysis

The cumualtive analysis considers the effects of impact producing factors related to the proposed action plus those related to prior and future OCS sales, State oil and gas activity, crude oil imports by tanker, and other commercial, military, and recreational offshore and coastal activities. These activities result in collisions, displacement, entanglement or contact with toxic substances; loss of habitat; and reduction of available food. Collision with or displacement by airborne or waterborne traffic is unlikely in the Western Gulf because of the small pelican population. The greatest hazard is in Corpus Christi Bay where 400-500 brown pelicans nest and roost. Even in this area, impacts are expected to be low because of the protection of the rookery by resource agencies and the lack of evidence that traffic will increase significantly. Entanglement in or ingestion of plastic discarded by oil and gas operators, waterborne commerce, fishermen, or municipalities is potentially lethal to individuals, but it is not significant to the regional population. Land development will continue in the coastal areas of the WPA (Table IV-2); however, it is unlikely to significantly impact the brown pelican because much of its nesting and roosting habitat is undeveloped public land and its protected status requires private land owners to mitigate habitat losses.

Oil spillage has the greatest cumulative potential for harming pelicans. There is a 38% probability of a large oil spill (1,000 bbls or greater) occurring and contacting the Corpus Christi rookery as a result of OCS sales and crude oil imports (Table IV-8). Access to the rookery would occur through the nearby passes, which would afford some protection and enhance cleanup success. Cumulatively, a few spill incidents of > 1 and ≤ 50 bbls are assumed to occur each year while incidents of small spills (> 50 and < 1,000 bbls) will occur at a frequency of less than one spill per year over the life of the proposed sale. A very few spills (> 1 and ≤ 50 bbls) will contact the Texas coastline during the 34-year lease life; one spill of the size class of > 50 and < 1,000 bbls will contact the shoreline. The chronic nature of small spills may result in a long-term, greater frequency of contact than large spills. The frequency of large and small spills suggests that population declines lasting about one generation could result. Contamination of food by oil spillage, storms, hurricanes, and other natural destructive events could cumulatively cause death or injury to several individuals, but it is unlikely to significantly impact the regional population. Based on the lethal and sublethal effects of spilled oil on pelicans and such a contact occurring, the resultant population decline will last one generation.

Conclusion

The cumulative impact is moderate.

High Case Analysis

The High Case is an optimistic estimate of development and production for the proposed action. The barrels produced, shuttle tanker traffic, the number of platforms, and the miles of offshore pipeline in the High Case are approximately double that of the Base Case (Tables IV-1 and IV-2). The increase in activities and production is accompanied by greater risk of adversely impacting brown pelicans by disturbance and oil spillage. As in the previous analyses, disturbances are unlikely to be significant because most activities are carried out away from pelican habitat. Oil spillage, potentially the greatest threat, would double in volume and occurrence. The Corpus Christi rookery would have a 2% probability of being contacted by one or more large oil spills. As discussed earlier, the impact of the contact would be minimized by the sheltered location of the rookery. Doubling the spillage volume and occurrence should not result in impacts greater than the Base Case. Vessel and air traffic would also increase, though not at the two fold rate of production. Traffic would continue to have a low impact on brown pelicans because of its negligible contribution to the total traffic in the Gulf and the improbability of interaction with pelicans. As in the Base Case, no new onshore support facilities would be built that would displace pelicans. A population decline caused by OCS oil and debris is expected to last less than one generation.

Conclusion

The impact is estimated to be low.

(b) Sea Turtles

Base Case Analysis

Normal OCS activities and accidents could adversely impact marine turtles. The normal activities with the greatest likelihood of impact are tanker and shuttle vessel traffic, the use of explosives, and coastal development. Turtles resting or swimming at the surface are susceptible to being struck by vessels. These collisions would probably be fatal. Although collisions appear to be common, the traffic associated with the proposed action is unlikely to result in a population decline lasting longer than one generation because of its negligible contribution to the total vessel traffic of the Gulf of Mexico.

Explosives are frequently used to remove structures, but rarely as a seismic source. The use of explosives could pose a threat to marine turtles. Turtles within 1,000 yards of a 200-lb nitromethane explosion experienced capillary damage, disorientation, and loss of motor control (Duronslet et al., 1986). Explosives were used in 58% of the structure removals between November 1986 through June 1988. The MMS observers at 17 of these removals sighted three turtles, none of which were injured by the removal operations. The proposed action will install approximately 20 structures, which will probably be removed within 25 years. The MMS guidelines regarding charge size/spacing and turtle detraction are expected to mitigate potential injury (Section IV.A.3.j.). Injury or death resulting from an explosion could affect a small number of individuals but these losses are unlikely to affect the regional population.

Entanglement in or ingestion of debris originating from platforms or support vessels can cause drowning, injury, digestive disorders or reduced mobility resulting in starvation. Analysis of stomach contents of necropsied stranded sea turtles indicated that 30%-50% of the victims had ingested plastic (Interagency Task Force, 1988). The MMS (30 CFR 250.40) and Public Law 100-220 (101 Statute 1458), MARPOL, Annex V, prohibit the disposal of plastics at sea or in coastal waters. Debris originating from the offshore oil and gas industry is unlikely to kill or injure any sea turtles. Oil spillage can affect sea turtles by toxic contact, ingestion, inhalation, and excessive expenditure of energy. Boesch and Rabalais (1987), Vargo et al. (1986), and Fritts and McGehee (1981) discuss these impacts in detail. Turtle eggs exposed to oil have resulted in hatchling deformities. Carr (1986) suggested that "lost year" turtles are most likely to contact oil because the currents that form the debris mats, which this life stage inhabits, also direct and concentrate spilled oil. These juveniles also ingest tar balls; such consumption frequently results in blockage of the digestive or respiratory system (Vargo et al., 1986). Although death from ingestion of OCS oil is possible, most oil produced in the Gulf of Mexico does not form tar balls because of its low asphatene components (Section IV.B.3.). Adult turtles display an avoidance of spills by increased dive time and by swimming away from the oil (Maxwell, 1979; Vargo et al., 1986). Oil spillage can also indirectly affect turtles by contamination of their food, which results in a scarcity of food or bioaccumulation of toxins. Based on the OSRA model, it is likely that if a large spill occurred it would not contact sea turtles in their nesting beaches on South Padre Island or their foraging areas along coastal Texas. Oil spillage of less than 1,000 bbls per incident are likely to occur as a result of the proposed action. It is assumed that there will be one spill per year for spills of > 1 and ≤ 50 bbls and one per 34 years for spills of > 50 and < 1,000 bbls. A spill incident of > 1 and ≤ 50 bbls is assumed to contact the coastline sometime during the 34-year lease life, while no spills of > 50 and < 1,000 bbls were to contact the coastline during the lease life. Small spills contacting turtles will have similar impacts; however, their size makes them more easily avoided and thereby less threatening. The absence of onshore construction, the absence of reported collisions, the low probability of collisions, the mitigating measures deployed during the use of explosives, the avoidance of oil, and the improbability of a contact with oil suggest that a population decline would last less than one generation.

Conclusion

The impact is estimated to be low.

Cumulative Analysis

The cumulative analysis considers the effects of impact producing factors related to the proposed action plus those related to prior and future OCS sales, State oil and gas activity, crude oil imports by tanker, and other commerical, military, and recreational offshore and coastal activities. Collisions with vessels will probably increase with the amount of traffic in the Gulf. Entanglement, especially in shrimp trawls should be reduced by legislation prohibiting the disposal of debris at sea and the use of turtle exclusion devices. Nesting areas will remain unimpacted by development because of their location on recreational public lands. The use of explosives may increase as the structures in the Western Gulf age. This increased hazard should be mitigated by the development of nonexplosive removal techniques and the explosive removal guidelines discussed above (Section IV.A.3.j.).

Cumulatively, there is a 52% chance of a large spill originating in the WPA and contacting the south Texas inshore areas frequented by turtles. Forty-two percent of these impacts are attributable to imported oil in tankers; the remainder (10%) are based on past, present, and future OCS sales. Imported oil has a higher percentage of asphaltine components than OCS-produced oil; this makes it more likely to produce tar balls, which could be ingested by turtles. There is also a 17% probability of a large spill contacting the turtle nesting beaches of Padre Island, Texas. Its sources are divided between imported oil (13%) and OCS oil sales (4%) (Table IV-8). The cumulative impact of a large spill originating in United States' waters contacting the nesting beaches of the Kemp's ridley turtle in Rancho Nuevo, Mexico, is negligible (Table IV-1). A few spills of > 1 and ≤ 50 bbls will occur each year. Based on the OSRA model and imported oil spill rates, it is likely that if a large spill occurred it would contact one or more sea turtles in the Western Gulf. A low occurrence will occur in proximity to coastal resources (less than one spill per year) and very few will contact the coast (during the lease life). Several spills of > 50 and < 1,000 bbls will occur during the lease life (less than one spill per year), only one of which will contact the coastline. Small spills would have similar hazards of inhalation, toxic contact, ingestion, and food source contamination. They are, however, more avoidable by adult turtles and less likely to contact turtle habitat than large spills. Conversely, their greater frequency of occurrence may result in greater contributions to the sargassum mat habitat utilized by juveniles. Based on the number of strandings caused by plastic ingestion and collisions, the high mortality of turtle eggs and immature turtles contacting or ingesting oil, and the high probability of such a contact occurring, the resultant population decline will last 2-3 generations.

Conclusion

The cumulative impact on marine turtles is high.

High Case Analysis

The High Case is an optimistic estimate of production and development of the proposed action. The barrels produced, shuttle tanker traffic, the number of platforms, and the miles of offshore pipeline in the High Case are approximately twice that of the Base Case (Tables IV-1 and IV-2). The increase in activities and production is accompanied by a greater risk of impacting marine turtles. Collision and oil spillage are anticipated to have the greatest impacts. Increases in shuttle and support traffic will remain a negligible portion of the total traffic in the Gulf of Mexico. The volume and frequency of oil spillage is expected to double based on the doubling of production. This would mean a 1% probability of a large spill contacting the Padre Island, Texas, nesting beaches and a 2% probability of contacting the south Texas inshore areas frequented by turtles (Table IV-8). A few spills of > 1 and ≤ 50 bbls are likely to occur each year, a low percentage of which will occur in proximity to the coast. During the 34-year lease life, a few will contact the coast. Spills of > 50 and < 1,000 bbls will occur more infrequently at a rate of a few per lease life with only one contacting the coastline during that period. Small spills cause similar impacts but would be more avoidable by adult turtles. Due to the chronic nature of small spills, they may, however, have a greater contact with juveniles inhabiting sargassum mats. Losses resulting from such spillage are likely to have an impact on less than 1% of the population for less than one generation. The doubling of the frequency and volume over the Base Case is not expected to produce impacts greater than the Base Case. Based on the absence of new onshore construction, the minor contribution of OCS shuttle and tanker traffic, the avoidance of oil by adult turtles and the low probability of a contact occurring, any resultant population decline will be less than one generation.

Conclusion

The impact under the High Case is estimated to be low.

(c) Whales

Base Case Analysis

Whales are infrequently sighted in the WPA (Fritts et al., 1983). The major whale habitat in the Gulf is in the deep water off the continental shelf. The endangered sperm whale is probably the most numerous whale species in this region and can be found most frequently in the Gulf during June through March along the 1,000-m contour (average of 1,167 m). Pods range from 2 to 14 individuals of mixed sexes and ages, and are usually associated with physical oceanographic features such as the Loop Current (Fritts et al., 1983; Table III-1). All of the OCS oil/gas activities occur on the shelf; however, as exploration and development increase in deepwater areas, there is an increasing probability of adversely impacting endangered whale species in the WPA. The activities and events affecting whales are similar to those described for marine mammals (Section IV.D.2.a.(6)). The significant impact producing factors that could potentially affect whales are Federal OCS-related oil spills, collision with offshore support vessels, use of explosives for the removal of offshore structures, underwater sound emissions, and entanglement/ingestion of offshore oil/gas-related plastic debris.

The most likely effects of oil on cetaceans are skin and eye irritation, baleen fouling, asphyxiation from inhalation of volatile fumes, food reduction or contamination, and oil ingestion (Geraci and St. Aubin, 1982; Goodale et al., 1981; Gruber, 1981). Cutaneous irritation and baleen fouling appear to be short lived when whales return to unoiled water. Asphyxiation by inhalation of noxious fumes is unlikely due to the rapid vaporization and dilution of such fumes; however, several whales off Iran died of respiratory stress, induced by oil inhalation (USDI, MMS, 1987c). Surface skimming baleen whales are most vulnerable to oil ingestion due to their feeding behavior, however Geraci and St. Aubin (1982) reported that grey whales appeared to avoid spilled oil by spending less time on the surface and blowing less frequently. Contamination of food sources and its effect on whales is not well documented but is presumed to be localized and short term due to the nature of oil spillage.

Based on the OSRA model, it is likely that if a spill occurs it will contact one or more whales during the life of the lease (Table IV-5). It is assumed that a spill of > 1 and ≤ 50 bbls is likely to occur each year. A low percentage will occur in proximity to coastal resources and one will contact the coast during the lease life. It is assumed that a spill of > 50 and < 1,000 bbls will occur during the lease life. Such a spill is unlikely to contact the coast. Oil spills occurring as a result of the proposed action are unlikely to result in mortality in the WPA because of the low potential for a whale contacting a spill and the transitory effects of oil on cetaceans.

There is also potential for indirect impacts on cetaceans through the impact of oil spills on their food sources (NAS, 1985) and through the impact of oil and other contaminants on their habitat (Sections IV.B.1.a.(2) and (3); Gaskin, 1982). The magnitude of such impacts has not been quantified, but it is expected that effects are sublethal.

Though rare, vessel collisions with whales have been reported by Slijper (1979) and Kraus (1987, personal communication). None have occurred in the Gulf of Mexico and observations of vessel avoidance have been documented off the California coast (BBN Laboratories, Inc., 1986). The absence of reported collisions in the Gulf and the minor contribution that the proposed action will add to the total maritime traffic suggest that collisions would have a very low impact on whales.

As a result of the proposed action, about 20 structures will be installed in the WPA (Table IV-2). In about 15-25 years these structures may be removed. Subsurface explosions have elicited a short-term avoidance reaction in migrating grey whales several miles away, but the NMFS has concluded that an endangered whale would probably need to be very close to the detonation to be killed. Such proximity is unlikely because of avoidance of structures and structure location being inshore of whale habitat. The greatest hazard of substance explosions appears to be sublethal stress and physical impairment to hearing.

Underwater sounds from seismic activities and well drilling apparently do not cause immediate harm to whales (Malme et al., 1984; Gales, 1982) (Section IV.A.3.g.). There is concern that subsurface sound may induce stress and have a cumulative effect on hearing or disrupt acoustic communication among whales. Acoustic disturbance is unlikely to be lethal or alter distribution because of the absence of OCS activities seaward of the continental shelf.

Whales can become entangled in plastic rope, netting, cargo straps, etc., and may ingest plastic/styrofoam materials that may cause injury or death (Laist, 1987). Although entanglement has been reported in the Atlantic and Pacific, none has been directly attributable to oil and gas extraction debris. No sale-related entanglement is expected. Plastic debris disposal at sea is prohibited by MMS regulations and Public Law (MARPOL, Annex V). Based on the absence of collisions, entanglement or contact with structures, and the minor effect of noise and short-term oil contact, the resultant population decline will last less than one generation.

Conclusion

The proposed action is estimated to have a very low impact on whales in the Western Gulf.

Cumulative Analysis

The past, future, and proposed State and Federal offshore oil and gas activities, oil imports, ocean dumping, maritime commerce, and destructive natural events may produce cumulative impacts on whales. The activities and their impacts are similar to those discussed for other marine mammals (Section IV.D.2.a.(6)). Activities that have localized impacts near oil and gas structures are unlikely to have much effect on whales because of their preference for deep water along the continental slope and beyond the continental shelf. Sublethal stress from avoidance of traffic, geophysical surveys and collisions will increase as maritime commerce and research increase. The absence of stress- or collision-related strandings suggest that these impacts are low.

Entanglement, primarily in fishing gear, is an issue of growing concern. Though there have not been reports in the Gulf, it is not impossible that whales could be entangled in cargo netting, longlines, or drift nets. The Center for Environmental Education (1988) reported that a pygmy sperm whale and minke whale were found stranded on the Texas coast, apparently from the ingestion of plastic. This verifies the hazard of ingestion but leaves the magnitude of the problem in question.

The effects of contacting, inhaling, or ingesting (either directly or through contaminated food) oil could have cumulative impacts on whales. Although the current rate of spillage appears avoidable by whales and the effects are generally sublethal, increased production (particularly in areas frequented by whales) may cause significant stress, illness, or mortality. Based on the OSRA model, it is likely that one or more large oil spills will occur in the Western Gulf from past, present, and future platform, pipeline, shuttle tanker, and import tanker sources, and will contact a whale during the life of the lease. Gulfwide there will be approximately 10 large spills from OCS activities and over 33 spills from imported oil during the production life (Table IV-5). It is also assumed that a few spills of > 1 and ≤ 50 bbls will occur each year during the production life; most will remain offshore while less than one per year will occur in proximity to coastal resources. Spills of > 50 and < 1,000 bbls will occur more infrequently--at a rate of several over the life of the lease sale--with only one contacting the coast. The impacts of large and small spills are similar. Although smaller spills are more avoidable because of their size, they may produce more chronic, long-term effects because of their frequency.

The major whale habitat in the Gulf of Mexico is on the continental slope and in deepwater areas off the continental shelf. Whale habitat in the Western Gulf and the potential impacts thereon are discussed in Sections IV.D.2.a.(2), (3), and (8). As oil/gas exploration and development occurs in deepwater areas, there will be a slight increase in the potential impacts to whales and in the potential indirect impacts to their food sources and habitat. Based on the infrequency of strandings caused by collision, plastic ingestion, oil spillage, and entanglement, a population decline of less than 1% could occur, lasting less than one generation.

Conclusion

The cumulative impact of activities in the Western Gulf is estimated to be low.

High Case Analysis

As described in previous sections, the High Case is an optimistic estimate of development and production for the proposed action. It is approximately twice the production, offshore pipelines, and structures as the Base Case. The impacts on whales will remain about the same as the Base Case despite the increase in activities and production. The increase in shuttle and support traffic will be negligible relative to the total maritime commerce of the Gulf. Impacts localized near structures, (i.e., formation discharges, operational noises, and explosive removals) are unlikely to impact whales because of their preferred deepwater habitat beyond the continental slope. Large oil spills will occur with a 26% probability in the High Case (Table IV-5). A few spills of > 1 and ≤ 50 bbls will occur each year, only a few of which will contact the coastline in the life of the lease. Spills of > 50 and < 1,000 bbls will occur more infrequently at a rate of a few during the lease life, with only one likely to contact the coastline in that period. The impacts of large and small spills are similar; however, small spills are assumed to be more avoidable because of their size, but make a greater contribution to chronic, long-term toxicity because of their higher rate of spillage. Based on the absence of whales stranded by collisions, contact with oil spills or platform discharges, and the likelihood that most impact producing factors are in areas not frequented by whales, a population decline of less than 1% could occur, lasting less than one generation.

Conclusion

The level of impact under the High Case is estimated to be low.

(6) Impacts on Marine Mammals

Nonendangered marine mammals are protected under the Marine Mammal Protection Act of 1972 and are discussed in this marine mammal section. Endangered marine mammals (most large whale species, manatees, etc.) are protected under the Endangered Species Act of 1973 and are discussed in Section IV.D.2.a.(5)(c). The bottlenose dolphin is the most common nonendangered marine mammal that occurs in the Gulf of Mexico (Fritts et al., 1983), and it is the subject of most nonendangered marine mammal research. Therefore, the bottlenose dolphin is used as the primary subject for this marine mammal discussion.

Base Case Analysis

Normal activities and accidental effects associated with OCS oil and gas extraction have direct and indirect impacts on marine mammals. These impacts are described in detail by MMS (USDI, MMS, 1987c), Geraci and St. Aubin (1988), National Research Council (1985) and Boesch and Rabalais (1987). Impacts associated with normal activities include stress induced by construction/operation noise, disturbance by traffic, noxious discharges, and concussion caused by explosives. Reaction to noise varies with species and type of sound. Most species are likely to habituate or show minimal reaction to seismic operations, shuttle and support traffic, and construction/operation activities because of their low intensity and frequency of occurrence. Impacts, if any, are estimated to be minor, short-term and localized based on observations of marine mammals off the California coast (USDI, MMS, 1987c). Disturbances associated with explosive structure removal would be localized but have a greater potential for inducing stress, injury, or death. The MMS explosive removal criteria limit the types and amounts of explosives, the spacing of explosions, and require the use of detraction techniques in an attempt to minimize serious injury. The MMS observers at 17 offshore oil/gas structure removals sighted small (2-5) pods of bottlenose dolphins (no whales) at five sites; no injuries to the dolphins were observed following the explosive severing of the structure.

Reports by the National Academy of Science (1985) suggest that drilling mud and formation discharges do not have a significant impact on marine mammals because they have limited interaction with biota and quickly dilute to background levels.

Accidental events that impact marine mammals include oil spills, vessel collisions, and entanglement/ingestion of marine debris. Species that feed or rest on the surface are most vulnerable to collisions with vessels. The OCS shuttle and support traffic are a negligible contribution to the total traffic in the Gulf of Mexico. The relatively small volume of traffic and the absence of reported accidents in the Gulf suggest that collisions are unlikely to occur. A rare accident will most likely result in the loss of no more than one individual to the population. Entanglement in or ingestion of marine debris can result in impaired mobility and blocked digestion, resulting in a loss of condition and death. Death by ingestion or entanglement appears to be a minor impact on marine mammal populations based on the small number of stranded mammals documented as having died of debris ingestion (Laist, 1987). Entanglement ingestion will have an impact on individuals but is unlikely to impact a population.

Oil spills affect marine mammals by skin and eye irritation, respiratory blockage or inhalation of noxious vapors, ingestion, and contamination of food. Based on the OSRA model, it is likely that if a large oil spill occurs it will contact one or more marine mammals during the lease life of the sale. The probability of contact and degree of impact are dependent on the species, composition of the oil, meteorological conditions, and the affect on their prey (Geraci and St. Aubin, 1988; Geraci and St. Aubin, 1982; Goodale et al., 1981; Gruber, 1981). Geraci and St. Aubin (1988) summarized the risk of oil on marine mammals by stating that the host of variables makes determination of vulnerability difficult; however, species with large ranges and mobility that feed in the water column verses the surface or bottom are less vulnerable to oil. Baleen whales are the most vulnerable, followed by bottlenose dolphins inhabiting the continental shelf and beyond. Also vulnerable are other toothed whales and dolphins, which are wide ranging. Although bottlenose dolphin habitat appears to make it more vulnerable to contact with spillage, a study suggests that they are able to detect and avoid oil (Geraci and St. Aubin, 1982). The ability to detect and avoid oil spills appears to vary with species. Skin and eye irritation and respiratory disorders caused by contacting oil appears minor and short-term (USDI, MMS, 1987c). Death or illness caused by oil ingestion and by consumption of contaminated food do not appear likely due to the volume of oil needed to cause a disorder; however, long-term impacts, which could shorten life expectancy or reduce fecundity, have not been studied. There is a 13% probability of one or more large spills occurring in the Western Gulf from OCS platform, pipeline and shuttle tanker activities during the production life. There is also a 99% probability that over 33 spills will occur somewhere in the Gulf during the lease life as a result of tanker-imported oil (Table IV-8). It is assumed that one spill of > 1 and ≤ 50 bbls will occur each year, with only one contacting the coastline during the 34-year lease life. Spills of > 50 and < 1,000 bbls will occur less frequently at a rate of one during the life of the lease. However, no spill would contact the coast. Large and small spills will have similar impacts; however, small spills are more avoidable by those species that discern oil, and their chronic frequency makes them a significant contributor to hydrocarbon accumulation in the environment. Based on the minor, localized and short-term nature of most acoustic disturbances, the absence of reported vessel collisions with marine mammals in the Gulf, the avoidance of oil spills by bottlenose dolphins and the great mobility of offshore species, a population decline lasting less than one generation is likely to occur.

Conclusion

The impact on marine mammals as a result of the proposed action is estimated to be low.

Cumulative Analysis

The past, proposed, and future State, and Federal offshore oil and gas activities, ocean dumping, maritime commerce, and destructive natural events may produce cumulative impacts on marine mammals. These activities could cause avoidance of preferred habitats, digestive and respiratory disorders from the ingestion of plastic, collisions, entanglement, explosive concussion, or contact with noxious substances and indirect impacts on food supplies. These impacts are discussed in the Base Case Analysis.

Collisions with vessels are rarely reported and none have been reported in the Gulf of Mexico. They appear to be insignificant because of their infrequency. Entanglement, particularly in fishing gear, has been reported in the Atlantic and Pacific (USDC, NMFS, 1987), but the extent of the impacts in the Gulf is undocumented. Acoustic injury and concussive shock from the use of explosives may increase as a growing number of structures are removed. Potential injury should be mitigated by MMS structure removal guidelines and nonexplosive removal techniques. The stress of traffic and acoustic disturbance is likely to increase as maritime commerce and oil/gas activities expand. Marine mammals appear to habituate to these disturbances and easily avoid collision. Stranding caused by the ingestion of debris is rarely reported, and is thought to be unlikely because of the ability of most nonendangered marine mammals to discern their prey. The marine disposal of radioactive waste, munitions, and chemicals could also cause death or illness to individuals. The number of deaths and injuries resulting from the ingestion of debris is unknown, but impacts on the regional population are thought to be low based on the small number of strandings.

There is an 88% probability of a large oil spill occurring in the Western Gulf (Table IV-5) as a result of oil produced in the Gulf of Mexico. There is a 99% probability of a spill from imported oil occurring during the production life of the proposed action. Based on the OSRA model, it is likely that if a large spill occurs it will contact one or more marine mammals. It is also assumed that a few spills of > 1 and ≤ 50 bbls will occur each year during the production life. Most will remain offshore, with less than one spill per year occurring in proximity to coastal resources. Spills of > 50 and < 1,000 bbls will occur more infrequently at a rate of several over the life of the lease, with only one spill contacting the coast. The impacts of large and small spills on marine mammals are similar. Although smaller spills are more avoidable because of their size, they may produce more chronic, long-term effects because of their frequency. This may be particularly true in the contamination of food. Based on minor, short-term and localized effects of acoustic and traffic disturbance; the absence of reported collisions; the limited number of reported deaths or injuries from ingestion/entanglement; explosive concussion; the minor, short-term localized effects of oil inhalation and contact; and the undocumented, long-term effects of ingestion and food source contamination, a population decline lasting less than one generation will occur.

Conclusion

The cumulative impact to marine mammals in the Western Gulf is estimated to be low.

High Case Analysis

As described in Section IV.A.1., the High Case is an optimistic estimate of development and production for the proposed action, which is approximately twice the production, offshore pipelines, and structures as the Base Case. The impacts on marine mammals are expected to remain about the same as the Base Case. Increases in shuttle and support traffic will be negligible relative to the total Gulf of Mexico traffic. Acoustic disturbances including explosive removals will have localized, sublethal impacts on individuals but are unlikely to affect the population. There is a 26% probability that a large oil spill (1,000 bbls or greater) will occur as a result of the High Case (Table IV-5). A few spills of > 1 and ≤ 50 bbls will occur each year, only a few of which will contact the coastline in the life of the lease. Spills of > 50 and < 1,000 bbls will occur more infrequently at a rate of a few during the lease life, with only one likely to contact the coastline in that period. It is assumed that small spills are more easily avoided by species that can detect spillage (i.e., bottlenose dolphin), but the chronic occurrence of small spills is more likely to result in a greater frequency of contact by undiscerning species. Chronic spillage will also maintain a higher background level of hydrocarbons in the environment.

Conclusion

Based on the minimal contribution of OCS support and tanker traffic to total maritime traffic, the temporary effects of most acoustic disturbances and the avoidance of spills by the most vulnerable species, the impact on marine mammals under the High Case is estimated to be low.

(7) Impacts on Birds Associated with the Coastal Area

For a generic discussion of impacts on birds associated with the coastal area, see Section IV.D.1.a.(7).

Base Case Analysis

The major impact producing factors analyzed below are sale-related oil spills, helicopter and vessel traffic, pipeline landfalls and coastal facility construction, and oil/gas-related plastic debris.

The majority of coastal and marine bird nesting habitats occur inshore, in coastal bays and marshes, behind barrier islands and beaches. The highest estimated probability of one or more large oil spills (1,000 bbls or greater) occurring and contacting a Western Gulf inshore bay is 1% (Galveston Bay). The estimated mean number of large spills occurring and contacting Galveston Bay is less than 0.05. The highest estimated probability of one or more large spills occurring and contacting Texas coastal marshes is 1%. The estimated mean number of large spills occurring and contacting Texas coastal marshes is less than 0.05 (Table IV-8).

The majority of the coastal and marine bird feeding habitats occur nearshore or offshore and could be contacted by OCS-related oil spills. The highest estimated probability of one or more large spills (1,000 bbls or greater) occurring and contacting a Western Gulf coastline is 1% (Galveston Island/Bolivar Peninsula). The estimated mean number of large spills occurring and contacting Galveston Island/Bolivar Peninsula is less than 0.05 (Table IV-8).

Small oil spills (less than 1,000 bbls) are subdivided into two size groups: chronic small spills (> 1 and ≤ 50 bbls) and small spills (> 50 and < 1,000 bbls). Section IV.B.2.b. estimates the mean number of small spills (less than 1,000 bbls) occurring from the proposed action. It is assumed that a chronic small spill (> 1 and ≤ 50 bbls) is likely to occur each year during the 34-year lease life. Low percentages of the total chronic small spills are assumed to occur in proximity to coastal resources. A few chronic small spills (> 1 and ≤ 50 bbls) are assumed to contact the coastline during the 34-year lease life. It is assumed that a small spill (> 50 and < 1,000 bbls) will occur during the 34-year lease life. However, it is assumed that no small spill (> 50 and < 1,000 bbls) will contact the coastline during the 34-year lease life.

Large oil spills (1,000 bbls or greater) originating "in port" from OCS-related shuttle tankering include those that may occur and contact coastal bays and estuaries. The highest estimated probability of one or more large spills from shuttle tankering occurring and contacting a Western Gulf bay or estuary is less than 1%. The estimated mean number of large spills from shuttle tankering occurring and contacting a Western Gulf bay or estuary is less than 0.01 (Section IV.B.1.f.).

It is unlikely that oil spills occurring as a result of the proposed action will interact with coastal and marine bird nesting and feeding habitats in the Western Gulf. Further, this analysis assumes that very little oiling of coastal and marine birds will occur. Therefore, this analysis assumes that no interaction of birds associated with the coastal area and sale-related oil spills will occur.

Disturbance of coastal and marine bird nesting and feeding habitats from pipeline landfalls, onshore construction, and noise associated with helicopter and vessel traffic could result in a reduction or desertion of birds that use the habitats (Wicker and Rabalais, 1988). Dredging and the construction of pipelines and roads could change hydrology, which may result in complete conversion of a marsh ecosystem (Section IV.D.1.a.(1)). However, no new OCS oil/gas-related pipeline landfalls or coastal facilities are projected as a result of the proposed action in the WPA (Table IV-2).

It is estimated that during the peak year of the proposed action 3,141 OCS oil/gas service vessel trips, 15 shuttle tanker trips, and 5,658 helicopter trips will occur (Table IV-2). This represents a negligible amount of the total annual vessel traffic in the Gulf of Mexico. The majority of the OCS oil/gas traffic occurs in/out of existing port areas; therefore, it is likely that this activity, as a result of the proposed action, will have a very low impact on birds associated with the coastal area in the WPA.

Coastal and marine birds can become entangled in monofilament fishing line, netting, 6-pack yokes, etc., which may result in injury or mortality. Ingestion of plastic/styrofoam materials may cause internal blockage, resulting in injury or mortality (Centaur Associates, Inc. and Center for Environmental Education, 1986). Ingested plastic may impair feeding activity where plastic reduces the food storage volume of the stomach and limits the accumulation of fat reserves essential for reproduction and migration (Ryan, 1988). Entanglement/ingestion of OCS oil/gas-related plastic debris by coastal and marine birds is not expected to have an impact as a result of the proposed action. The MMS prohibits the disposal of equipment, containers, and other materials into offshore waters by lessees (30 CFR 250.40). In addition, MARPOL, Annex V, Public Law 100-220 (101 Statute 1458), which prohibits the disposal of any plastics at sea or in coastal waters, will go into effect January 1, 1989.

Conclusion

A very low level of impact on birds associated with the coastal area and their feeding and nesting habitats is estimated to occur in the Western Gulf as a result of the Base Case.

Cumulative Analysis

This cumulative analysis considers the effects of impact producing factors related to the proposed action plus those related to prior and future OCS sales, State oil and gas activity, crude oil imports by tanker, and other commercial, military, and recreational offshore and coastal activities that may occur and adversely affect birds associated with the coastal area. Specific types of impact producing factors considered in the analysis include oil spills, helicopter and vessel traffic, pipeline landfalls and coastal construction, dredging, fishing gear, plastic debris, and water contamination.

The estimated probability of one or more large oil spills (1,000 bbls or greater), resulting from the proposed action, prior and future OCS leasing, and the tankering of imported oil, occurring and contacting land in the Gulf of Mexico is greater than 99%. The estimated mean number of large spills to occur and contact land in the Gulf is 5.5. Galveston County, Texas, is the land segment with the highest probability (50%) of being contacted by one or more large spills. Galveston Bay is the coastal inshore bay with the highest probability (50%) of being contacted by one or more large spills. The estimated probability of one or more large spills occurring and contacting Texas coastal marshes is 64%. The estimated mean number of large spills to occur and contact Texas coastal marshes is 1.0 (Table IV-8).

Section IV.B.2.b. estimates the mean number of small spills (less than 1,000 bbls) occurring from the proposed action and other impact producing factors mentioned above. It is assumed that a moderate number of chronic small spills (> 1 and ≤ 50 bbls) would occur each year. A few chronic small spills would occur each year in each OCS analysis area in proximity to coastal environments. A few chronic small spills are assumed to contact the coastline each year. It is assumed that a few small spills (> 50 and < 1,000 bbls) would occur each year. A few small spills are assumed to contact the coastline during the 34-year lease life.

Large oil spills (1,000 bbls or greater) originating "in port" from the tankering of imported oil include those that may occur and contact bays and estuaries. The highest estimated probability of one or more large oil spills from tankering of imported oil occurring and contacting a Western Gulf bay or estuary is 98% (Houston, Texas). The estimated mean number of large spills from tankering of imported oil occurring and contacting a Western Gulf bay or estuary is 3.91 (Section IV.B.1.d.).

Due to the high aggregate probability of oil spills occurring and contacting the Western Gulf coastline and coastal inshore bays and marshes, it is very likely that some oil spills will occur and contact coastal and marine birds and their feeding and nesting habitats in some localized areas. Further, this analysis assumes that oil spills will contact feeding and nesting habitats. Therefore, it is expected that there will be a moderate impact on birds associated with the coastal area in the WPA from oil spills.

Disturbance from helicopter and vessel traffic in the vicinity of bird feeding and nesting habitats in the WPA is unlikely to increase above current levels as a result of OCS-related oil/gas activities from the proposed action. The cumulative service vessel trips are estimated at 17,885, shuttle tankering trips at 126, and helicopter trips at 32,485 (Table IV-2). This represents a negligible amount of the total annual vessel traffic in the Gulf of Mexico. The majority of the OCS-related oil/gas traffic occurs in/out of existing port areas. Cumulative disturbance from helicopter and vessel traffic is likely to have a low impact on coastal and marine birds in localized high traffic areas.

Cumulative impacts will moderately increase as a result of OCS-related onshore construction of 4 pipeline landfalls, 100 miles of onshore pipeline, and 3 marine terminals (Table IV-2).

Impacts unrelated to OCS activities include the loss of habitats to commercial, military, recreational, and residential construction. Dredging and draining of wetland areas along migratory flyways, in coastal feeding areas, and in overwintering areas causes additional habitat loss. Entanglement in commercial and recreational fishing gear and plastic debris causes injuries/death of birds. Coastal storms and hurricanes cause flooding and destruction of nesting areas, resulting in coastal and marine bird losses. High levels of oil and organic chemical contamination in the river runoff into the northern Gulf of Mexico could cause direct mortality or cause indirect food loss to avian species. Collision with power lines and supporting towers causes additional bird mortality (Avery et al., 1980). These impact producing factors, in aggregate, are judged to result in a moderate amount of adverse effects on birds associated with the coastal area by the destruction, alteration, and/or disturbance of feeding and overwintering areas and by injury and mortality of numerous individual coastal and marine birds.

Conclusion

A moderate level of cumulative impact on birds associated with the coastal area and their feeding and nesting habitats is estimated to occur in the Western Gulf as a result of the proposed action, prior and future OCS sales, and other impact producing factors.

High Case Analysis

The major impact producing factors analyzed below are sale-related oil spills, helicopter and vessel traffic, pipeline landfalls and coastal facility construction, and oil/gas-related plastic debris.

Galveston County, Texas, is the land segment with the highest probability (2%) of being contacted by one or more large oil spills (1,000 bbls or greater). The estimated mean number of large spills occurring and contacting Galveston County is less than 0.05. Galveston Bay is the coastal inshore bay with the highest probability (2%) of being contacted by one or more large oil spills. The estimated mean number of large spills occurring and contacting Galveston Bay is less then 0.05. The highest probability of one or more large spills occurring and contacting Texas coastal marshes is 3%. The estimated mean number of large spills occurring and contacting Texas coastal marshes is less than 0.05 (Table IV-8).

Small oil spills (less than 1,000 bbls) are subdivided into two size groups: chronic small spills (> 1 and ≤ 50 bbls) and small spills (> 50 and < 1,000 bbls). Section IV.B.2.b. estimates the mean number of small spills (less than 1,000 bbls) occurring from the proposed action. It is assumed that a chronic small spill (> 1 and ≤ 50 bbls) is likely to occur each year during the 34-year lease life. Low percentages of the total chronic small spills are assumed to occur in proximity to coastal resources. A few chronic small spills (> 1 and ≤ 50 bbls) are assumed to contact the coastline during the 34-year lease life. It is assumed that a few small spills (> 50 and < 1,000 bbls) will occur during the 34-year lease life. It is assumed that a small spill (> 50 and < 1,000 bbls) will contact the coastline during the 34-year lease life.

Large oil spills (1,000 bbls or greater) originating "in port" from OCS-related shuttle tankering may include those that occur and contact bays and estuaries. The highest estimated probability of one or more large oil spills from shuttle tankering occurring and contacting a Western Gulf bay or estuary is 1% (Houston, Texas). The estimated mean number of large spills from shuttle tankering occurring and contacting a Western Gulf bay or estuary is 0.01 (Section IV.B.1.).

It is unlikely that oil spills occurring as a result of the proposed action will interact to an appreciable extent with coastal and marine bird nesting and feeding habitats in the Western Gulf. Further, this analysis assumes that very little oiling of coastal and marine birds will occur. Therefore, this analysis assumes that no interaction of birds associated with the coastal area and sale-related oil spills will occur.

Disturbance of coastal and marine bird nesting and feeding habitats from pipeline landfalls, onshore construction, and associated noise from helicopter and OCS oil/gas service vessel, and shuttle tanker traffic could result in a reduction or elimination of birds that use the habitats (Wicker and Rabalais, 1988). Dredging and the construction of pipelines and roads could change hydrology, which may result in complete conversion of the marsh ecosystem. However, no new OCS oil/gas-related pipeline or onshore construction, which may affect coastal and marine bird habitats, is projected as a result of the proposed action in the WPA (Table IV-2).

It is estimated that during the peak year of this proposed action 5,242 OCS oil/gas service vessel trips, 122 shuttle tanker trips, and 9,491 helicopter trips will occur (Table IV-2). This represents a negligible amount of the total annual vessel traffic in the Gulf of Mexico. The majority of the OCS-related oil/gas traffic occurs in/out of existing port areas; therefore, it is likely that this activity, as a result of the proposed action, will have a very low impact on birds associated with the coastal area in the WPA.

It is estimated that entanglement/ingestion of plastic debris from offshore oil/gas-related activities is unlikely to have an impact on coastal and marine birds in the WPA as a result of the proposed action.

Conclusion

A very low level of impact on birds associated with the coastal area and their feeding and nesting habitats is estimated to occur in the Western Gulf as a result of the High Case.

(8) Impacts on the Commercial Fishing Industry

For a generic discussion of impacts on the commercial fishing industry, see Section IV.D.1.a.(8).

Base Case Analysis

The major impact sale-related producing factors analyzed below are sale-related production platform emplacement and oil spills. Other impact producing factors including underwater OCS obstructions, discharge of drilling muds, emplacement of pipelines, dredging of canals, and structure removals are discussed above. Gear conflicts caused by underwater OCS obstructions are mitigated by the Fishermen's Contingency Fund. The dredging of canals and the emplacement of pipelines will contribute to fishery habitat loss and, therefore, negatively impact fishery resources. Drilling mud discharges (Table IV-2) contain chemicals that are toxic to marine fishes; however, this is only at concentrations four or five orders of magnitude higher than those found more than a few meters from the discharge point. Structure removal results in habitat loss and causes fish kills when explosives are used. In conclusion, although these other impact producing factors can negatively influence commercial fishery industries, with regard to the proposed action, they contribute a very negligible effect.

Twenty offshore platforms/structures (Table IV-2) are expected to result from the proposed action, eliminating less than 0.1% (225 acres) of the trawling area in the WPA. This loss of trawling area would result in a very low impact.

Table IV-8 identifies the projected risk of one or more large oil spills (1,000 bbls or greater) occurring and contacting the coastal bays and marshes critical to the well being of the commercial fishing industries in the WPA. The highest risk of one or more large oil spills occurring and contacting a coastal bay in the Western Gulf is 1% (Galveston Bay). The estimated mean number of large spills occurring and contacting Galveston Bay is less than 0.05. The highest estimated probability of one or more large spills occurring and contacting Texas coastal marshes is 1%. The estimated mean number of large spills occurring and contacting Texas coastal marshes is less than 0.05 (Table IV-8).

Small oil spills (less than 1,000 bbls) are subdivided into two size groups: chronic small spills (> 1 and ≤ 50 bbls) and small spills (> 50 and < 1,000 bbls). Section IV.B.2.b. estimates the mean number of small spills (less than 1,000 bbls) occurring from the proposed action. It is assumed that a chronic small spill (> 1 and ≤ 50 bbls) is likely to occur each year during the 34-year lease life. Low percentages of the total chronic small spills are assumed to occur in proximity to coastal resources. A few chronic small spills (> 1 and ≤ 50 bbls) are assumed to contact the coastline during the 34-year lease life. It is assumed that a small spill (> 50 and < 1,000 bbls) will occur during the 34-year lease life. However, it is assumed that no small spill (> 50 and < 1,000 bbls) will contact the coastline during the 34-year lease life.

Large oil spills (1,000 bbls or greater) originating "in port" from OCS-related shuttle tankering include those that may occur and contact coastal bays and estuaries. The highest estimated probability of one or more large spills from shuttle tankering occurring and contacting a Western Gulf bay or estuary is less than 1%. The estimated mean number of large spills from shuttle tankering occurring and contacting a Western Gulf bay or estuary is less than 0.05 (Section IV.B.1.d.).

It is unlikely that oil spills occurring as a result of the proposed action will interact with commercial fishery resources in the Western Gulf. Therefore, this analysis assumes that no interaction of commercial fisheries resources and sale-related oil spills will occur and that a very low level of impact will result. As a singular example, the highest estimated probability of one or more large oil spills (1,000 bbls or greater) occurring and contacting Gulf menhaden during their winter spawning in the WPA is less than 0.5%. The estimated mean number of large spills occurring and contacting Gulf menhaden at that time and location is less than 0.05 (Table IV-8).

Conclusion

A very low level of impact on the commercial fishing industry is estimated to occur in the Western Gulf as a result of the Base Case.

Cumulative Analysis

This cumulative analysis considers the effects of impact producing factors related to the proposed action plus those related to the Central Gulf proposed action, prior and future OCS sales, State oil and gas activity, crude oil imports by tanker, and offshore recreational fishing that may occur and adversely affect the commercial fishing industry in the same general area that may be affected by OCS oil and gas activity located in the WPA. Specific types of impact producing factors considered in the analysis include oil spills, offshore oil and gas platforms, commercial fishing techniques/practices, space use conflicts, and wetlands loss.

The 190 additional platforms resulting from the proposed action plus prior and future OCS sales in the WPA (Table IV-2) are estimated to reduce trawling area in the WPA by about 760 acres or less than 0.1%. This loss of trawling area should result in a very low impact.

The estimated probability of one or more large oil spills (1,000 bbls or greater), resulting from the proposed action, prior and future OCS leasing, and the tankering of imported oil, occurring and contacting land in the Gulf of Mexico is greater than 99%. The estimated mean number of large spills to occur and contact land in the Gulf is 5.5. Galveston County, Texas, is the land segment with the highest probability (50%) of being contacted by one or more large spills. Galveston Bay is the coastal inshore bay with the highest probability (50%) of being contacted by one or more large spills. The estimated probability of one or more large spills occurring and contacting Texas coastal marshes is 64%. The estimated mean number of large spills to occur and contact Texas coastal marshes is 1.0 (Table IV-8).

Section IV.B.2.b. estimates the mean number of small spills (less than 1,000 bbls) occurring from the proposed action and other impact producing factors mentioned above. It is assumed that a moderate number of chronic small spills (> 1 and ≤ 50 bbls) would occur each year. A few chronic small spills would occur each year in each OCS analysis area in proximity to coastal environments. A few chronic small spills are assumed to contact the coastline each year. It is assumed that a few small spills (> 50 and < 1,000 bbls) would occur each year. A few small spills are assumed to contact the coastline during the 34-year lease life.

Large oil spills (1,000 bbls or greater) originating "in port" from the tankering of imported oil include those that may occur and contact bays and estuaries. The highest estimated probability of one or more large oil spills from tankering of imported oil occurring and contacting a Western Gulf bay or estuary is 98% (Houston, Texas). The estimated mean number of large spills from tankering of imported oil occurring and contacting a Western Gulf bay or estuary is 3.91 (Section IV.B.1.d.).

Due to the high aggregate probability of oil spills occurring and contacting the Western Gulf coastline and coastal inshore bays and marshes, it is very likely that some oil spills will contact and interact with commercial fishery resources in their spawning and/or nursery habitats. Therefore, this analysis assumes that oil spills will contact spawning and/or nursery habitats and that a high level of impact will result. The highest estimated probability of one or more large oil spills (1,000 bbls or greater) occurring and contacting Gulf menhaden during their winter spawning in the WPA is 61%. The estimated mean number of large spills occurring and contacting Gulf menhaden at that time and location is 0.9 (Table IV-8).

Commercial fisheries in the Gulf of Mexico are also impacted by activities and events other than the oil and gas industry. Competition between large numbers of commercial fishermen, between commercial operations employing different fishing methods, and between commercial and recreational fishermen for a given fishery resource, as well as natural phenomena such as weather, hypoxia, and red tides, may reduce standing populations. Fishing techniques such as trawling, gill netting, or purse seining, when practiced non-selectively, may reduce the standing stocks of the desired target species as well as significantly impact species other than the target. In addition, the shrimping industry, discarding large numbers of groundfish such as croakers and spot in their by-catch, may be contributing to substantial reductions in the numbers of these commercial species. Space use conflicts can result from different forms of commercial operations and between commercial and recreational fisheries. In the Western Gulf, for example, crab trapping and inshore shrimping operations may occur in the same area, resulting in the loss of fishing area to one or the other or in gear conflicts when both operations attempt to use the same space. Also, wetlands loss is being closely studied to determine in what way and to what extent this loss affects commercial fisheries. Finally, hurricanes may impact commercial fisheries by destroying oyster reefs, damaging gear and shore facilities, and changing physical characteristics of estuaries. With the exception of hurricanes, these impacts are of a short-term nature.

Conclusion

A high level of cumulative impact on the commercial fishing industry is estimated to occur in the Western Gulf as a result of the proposed action, prior and future OCS sales, and other impact producing factors, added to the widely varying baseline conditions resulting from natural environmental factors.

High Case Analysis

The major impact producing factors analyzed below are sale-related production platform emplacement and oil spills. Although, as previously discussed, other impact producing factors can negatively influence commercial fishery industries, with regard to the proposed action, they contribute a very negligible effect.

Forty offshore platforms/structures (Table IV-2) are expected to result from the proposed action, eliminating less than 0.1% (360 acres) of the trawling area in the WPA. This loss of trawling area would result in a very low impact.

Galveston County, Texas, is the land segment with the highest probability (2%) of being contacted by one or more large oil spills (1,000 bbls or greater). The estimated mean number of large spills occurring and contacting Galveston County is less than 0.05. Galveston Bay is the coastal inshore bay with the highest probability (2%) of being contacted by one or more large oil spills. The estimated mean number of large spills occurring and contacting Galveston Bay is less than 0.05. The highest probability of one or more large spills occurring and contacting Texas coastal marshes is 3%. The estimated mean number of large spills occurring and contacting Texas coastal marshes is less than 0.05 (Table IV-8).

Small oil spills (less than 1,000 bbls) are subdivided into two size groups: chronic small spills (> 1 and ≤ 50 bbls) and small spills (> 50 and < 1,000 bbls). Section IV.B.2.b. estimates the mean number of small spills (less than 1,000 bbls) occurring from the proposed action. It is assumed that a chronic small spill (> 1 and ≤ 50 bbls) is likely to occur each year during the 34-year lease life. Low percentages of the total chronic small spills are assumed to occur in proximity to coastal resources. A few chronic small spills (> 1 and ≤ 50 bbls) are assumed to contact the coastline during the 34-year lease life. It is assumed that a few small spills (> 50 and < 1,000 bbls) will occur during the 34-year lease life. It is assumed that a small spill (> 50 and < 1,000 bbls) will contact the coastline during the 34-year lease life.

Large oil spills (1,000 bbls or greater) originating "in port" from OCS-related shuttle tankering may include those that occur and contact bays and estuaries. The highest estimated probability of one or more large oil spills from shuttle tankering occurring and contacting a Western Gulf bay or estuary is 1% (Houston, Texas). The estimated mean number of large spills from shuttle tankering occurring and contacting a Western Gulf bay or estuary is 0.01 (Section IV.B.1.d.).

It is unlikely that oil spills occurring as a result of the proposed action will interact to an appreciable extent with commercial fishery resources in the Western Gulf. Therefore, this analysis assumes that oil spills will contact spawning and/or nursery habitats and that a high level of impact will result. The highest estimated probability of one or more large oil spills (1,000 bbls or greater) occurring and contacting Gulf menhaden during their winter spawning in the WPA is less than 0.5%. The estimated mean number of large spills occurring and contacting Gulf menhaden at that time and location is less than 0.05 (Table IV-8).

Conclusion

A very low level of impact on the commercial fishing industry is estimated to occur in the Western Gulf as a result of the High Case.

(9) Impacts on Recreational Beach Use

Section IV.D.1.a.(9) presents a general discussion regarding chronic trash and debris and large oil spills (1,000 bbls or greater) as the major threats to use and appreciation of recreational beaches exposed to Gulf of Mexico OCS leasing and development. Standards for judging the level of impact from OCS lease sales on recreational beach use are listed in Table S-4. Visual No. 3 identifies the general location of major shorefront recreational beaches along the Texas shorefront and lists specific beaches by county on the back.

Base Case Analysis

Exploration and production on blocks leased in the Western Gulf of Mexico under the proposed action could lead to a large oil spill, which could be carried by winds, waves, and currents to interact with a major shorefront recreational beach in Texas. There is up to a 2% chance of one large oil spill (1,000 bbls or greater) occurring and contacting major recreational beaches along the Texas coast (Table IV-8). It is assumed, therefore, for purposes of this analysis, that a large oil spill will not impact recreational beaches anywhere along the Texas coast. A few smaller spills could, however, occur and contact recreational beaches (Section IV.B.2.). As was noted from historic spill impact experiences along Texas beaches (IXTOC, Alvenus), the interaction of a large spill can lead to temporary beach closures, sand removal, displacement of recreational activity, and economic consequences which will directly affect the businesses and support services directly associated with the beaches impacted, and it can indirectly spread throughout the community if the spill effects and publicity persist, or occur during peak season. Offshore operations associated with exploration, development, servicing, production, and product transmission will result in some floatable or semi-buoyant trash and debris entering the Gulf. This trash and debris is expected to affect beach aesthetics and increase maintenance requirements. Much of the trash, debris, and refuse associated with the offshore industry is environmentally persistent material that comes ashore and remains within the beach zone until removed by man or nature. Because of this persistence and Gulf transport mechanisms, trash from leases throughout the Central, Western and Eastern Gulf are likely to impact Texas beaches. This problem and its affect on beach use and maintenance becomes most serious in its cumulative context. New operational practices, training, and worker awareness programs were initiated by MMS and the petroleum industry in 1985. These programs focus on the beach litter problem and are expected to minimize the level of indiscriminate and irresponsible trash disposal from OCS oil and gas operations.

Conclusion

The proposed action is expected to result in a low impact on recreational beach use along the Texas coast.

Cumulative Analysis

This cumulative analysis considers the effects of impact producing factors related to the proposed action in the WPA plus those related to the Central Gulf proposed sale, prior and future OCS Gulf sales, State offshore oil and gas activity, offshore oil and gas activity in the Republic of Mexico, commercial and recreational fishing, defense operations, and other offshore and coastal activity around the Gulf rim which can result in debris, litter, trash and pollution that may occur and adversely affect major recreational beaches in the same general area that may be affected by OCS oil and gas activity located in the WPA. Specific impact producing factors include oil spills, trash, litter, and debris.

There is a 78% chance of one or more (with a mean number of 1.5) large oil spills (1,000 bbls or greater) occurring from past, present, and future sales, as well as import tankering, which could contact major recreational beaches in Texas (Table IV-8). Assuming one major spill, the oil pollution together with industrial litter from offshore operations in the Western Gulf are most likely to impact Texas recreational beaches in Galveston County (50% probability). Consequently, there will be short-term disturbance causing temporary loss or displacement of water-related, nearshore recreational activity and associated economic activity on specific beaches actually impacted (Galveston Island State Park or Steward Beach, for example).

As noted in Section IV.B.2., many chronic small spills (> 1 and ≤ 50 bbls) and small spills (> 50 and < 1,000 bbls) are expected to occur from operations, and a chronic small spill (> 1 and ≤ 50 bbls) is assumed to contact recreational beaches during the 34-year lease life. Spills less than 50 bbls, which are not contained prior to impact, can be cleaned from recreational beaches with little disruption of normal recreational activities and with minimal effects on beach recreational resources.

Continued and expanded oil and gas operations on the OCS throughout the Gulf of Mexico could contribute to an already serious problem of human and industrial debris on coastal shorefronts, which detracts from the aesthetic quality of recreational beaches and increases the cost of beach maintenance programs currently estimated at $14 million a year in Texas. Other factors such as oil and gas development in Mexican waters, in State territorial waters, offshore commercial and recreational fishing, merchant shipping and naval operations, as well as recreational use of beaches themselves and natural causes, also contribute to the debris problem and oil spill risk currently existing on the major recreational beaches of the WPA (USDI, MMS, 1988c).

More recent investigations and evaluations from the 1986 beach cleanups in Texas indicate 2,772 volunteers collected 125 tons of debris from 122 miles of Texas shorefront, for an average of approximately one ton per mile (CEE, 1977). Findings from the 1987 cleanup, which involved over 7,000 volunteers cleaning 157 miles of Texas beaches, are similar in content to the 1986 findings (CEE, 1988). Plastics (including styrofoam), a persistent and very bouyant basic material widely used in marine and coastal products and packaging, made up the vast majority (66%-67%) of the six trash item categories collected and analyzed from Texas beaches in 1986 and 1987. Although the CEE reports discuss findings in relation to probable sources (cargo associated wastes, galley wastes, operational goods, and fishing gear), it is impossible to relate the majority of the items collected to distinct coastal or offshore industry or user groups. Some specific items collected can be definitely associated with the oil and gas industry; however, we have no basis to conclude from the data collected what percentage offshore oil and gas operations in Federal waters contribute to the beach litter currently affecting Texas beaches.

Finding 484 hard hats, which are not disposable trash items, along Texas beaches during five coastal cleanups from 1986-1988 reflects the presence of a very large and active offshore oil and gas industry working throughout the Gulf of Mexico in open spaces during all types of weather conditions (over 30,000 offshore workers associated with U.S. Gulf of Mexico petroleum operations alone). The recently published CEE report on the findings of the September 1987 Texas Coastal Cleanup (CEE, 1988) indicate hard hats were encountered at a rate of 1.4 per mile. Computer write rings, a disposable plastic item believed to be predominately associated with offshore seismic geological and geophysical data gathering operations, were encountered at a rate of 15 per mile during the September 1987 cleanup. Drums, an item requiring special identification markings when used in OCS oil and gas operations, were located at a rate of over 3 per mile during the September 1987 cleanup. Even if only a portion of these items stem from prelease and postlease oil and gas operations, it is evident there is a need for better control and handling of equipment and disposable items used offshore.

As reflected in Final EIS 118/122 (USDI, MMS, 1988c, pages IV-179 through IV-181) and discussed in some detail in Section IV.D.1.a.(9), the petroleum industry and MMS at the district, regional, and national levels have taken many initiatives over the last 3 years to minimize careless loss and illegal disposal of solid waste from OCS oil and gas operations in the Gulf of Mexico. Furthermore, oil companies and their employees are demonstrating institutional and individual commitment to mitigation of the cumulative effects of marine debris on Texas beaches through cooperation, support, and participation in coastal cleanups and beach adoption projects throughout coastal Texas.

New international and national prohibitions against solid waste disposal in the Gulf of Mexico, directed at all marine industries along with public and private efforts to voluntarily develop a no-dumping ethic among all commercial and recreational users of the Gulf of Mexico, should begin to show results through a significant reduction in marine litter, trash, and garbage along Texas beaches.

Conclusion

The level of cumulative impact on recreational beach use in Texas is estimated to be high with one or two large oil spills and chronic trash and litter among the major contributing factors.

High Case Analysis

Based on the High Case outlined in Table IV-2, approximately 1.8 times more offshore activity and over twice the oil production associated with the Base Case is likely to occur; therefore, the potential for oil spills will about double and the increment in trash loss is likely to increase proportionately with additional exposure of man hours and equipment offshore. Under the High Case, there is a 4% chance (Table IV-8) that a large spill (1,000 bbls or greater) will occur and contact beaches in the Western coastal area. Therefore, we continue to assume no large spills are likely to occur as a result of the proposal. Debris, trash, and a small spill and a few chronic spills associated with offshore operations are likely to cause intermittent aesthetic and maintenance problems on Texas beaches.

Conclusion

The level of impact for the High Case on recreational beach use is expected to be low.

(10) Impacts on Archaeological Resources

Impacts to archaeological resources could occur as a result of an actual physical destruction of an artifact, disruption of the horizontal and vertical matrix in which the archaeological resource occurs, and contamination of organic site material with hydrocarbons, which could destroy the C-14 dating potential of the material. The major impact producing factors that could threaten archaeological resources include physical destruction or disruption from placement of drilling rigs, production platforms, and pipelines; impacts from anchoring activities; and impacts from oil spills. The OCS oil and gas activities will also generate tons of ferromagnetic structures and debris, which will tend to mask magnetic signatures of significant historic archaeological resources. The task of locating historic resources through an archaeological survey is, therefore, made more difficult as a result of leasing activity.

(a) Historic

Base Case Analysis

Of the 1,589 ships known to have sunk in the northern Gulf of Mexico between 1500 and 1945, the locations of only 110 are known with sufficient accuracy to permit reliable mapping (Table III-17 of Final EIS 110/112). Of these 110 shipwrecks with known locations, 17 occur within the WPA. Four of the 17 ships date from the nineteenth century, and the remainder are twentieth century ships (Table III-19 of Final EIS 110/112).

The U.S.S. Hatteras is the only one of the 17 shipwrecks with known location in the WPA that has been groundtruthed and evaluated for National Register eligibility. The historical significance of the twentieth century ships is probably low, and most would not qualify for inclusion in the National Register of Historic Places.

Although relatively precise locations are known for only 17 potentially significant shipwrecks in the Western Gulf, a high probability zone (Archaeological Resources Zone 1) for the occurrence of wrecks was established during the archaeological resources baseline study (CEI, 1977). The MMS is currently funding a study (Contract

No. 14-12-0001-30330) that will reevaluate the current boundary of Archaeological Resources Zone 1. The results of this study should be available for inclusion in Final EIS 123/125.

Offshore development could result in an interaction between a drilling rig, platform, pipeline, or anchors and an historic shipwreck. This direct physical contact with a wreck site could destroy fragile ship remains, such as the hull and wooden or ceramic artifacts, and could disturb the site context. The result would be the loss of archaeological data on ship construction, cargo, social organization of the vessel's crew, and the concomitant loss of information on maritime culture for the time period from which the ship dates.

Since likely locations of archaeological sites cannot be delineated without first conducting a remote sensing survey of the seabed and near-surface sediments, MMS requires that an archaeological survey is conducted prior to development of lease tracts within Archaeological Zones 1 and 2. Generally, in the western part of the WPA, where unconsolidated sediments are thicker, it is more likely that side scan sonar, which has limited penetrability, will not detect shipwrecks buried beneath the mud. In this area, (subplanning area W-1), the effectiveness of the survey for detecting historic shipwrecks of composite and wooden construction would depend on the capability of a magnetometer towed at a 150-m linespacing (as specified in the archaeological survey requirements) to detect magnetic objects of the size characteristically associated with shipwrecks. Clausen and Arnold (1975) assess magnetometer reliability for detecting ferrous objects under these conditions at 25%-30%. Although the potential for a direct physical contact between an impact producing factor and a shipwreck is unknown in this area, the survey would reduce the potential for an interaction by only 25%-30%. Therefore, in the western part of the WPA, there would still be the potential for a high to very high impact.

In the eastern part of the WPA, where shipwrecks are more likely to be detected by side scan sonar, the potential for a direct physical contact between an impact producing factor and a shipwreck would be reduced by an estimated 90%. Therefore, the effectiveness of the survey would reduce the potential impact to historic shipwrecks in the eastern part of the WPA to very low.

Onshore historic properties include sites, structures, and objects such as historic buildings, forts, lighthouses, homesteads, cemeteries, and battlefields. Sites already listed on the National Register of Historic Places and those considered eligible for the Register (Visual No. 3) have already been evaluated as being able to make a unique or significant contribution to science. Presently unidentified onshore historic sites may contain unique historic information and would have to be assessed after discovery to determine the importance of the data.

Onshore development as a result of the proposed action could result in the direct physical contact between the construction of new onshore facilities or pipeline canals and previously unidentified historic sites. This direct physical contact with an historic site could cause physical damage to, or complete destruction of, historic sites, structures, and artifacts, and could disturb site context. The result would be the loss of information on the history of the region and the Nation. Often, information contained in historical sites is previously undocumented in written accounts and may be the only surviving source of that information. No new onshore facilities or pipeline landfalls are projected for the Western Gulf for Sale 125. There is, therefore, no expected impact to either onshore historic sites or offshore shipwrecks in the WPA from onshore development.

Should an oil spill contact a coastal historic site, such as a fort or a lighthouse, the major impact would be visual due to oil contamination of the site and its environment. This impact would probably be temporary and reversible with no actual loss of information. The expected impacts to coastal historic sites from spilled oil would, therefore, be very low.

Since all platform locations within Archaeological Zones 1 and 2 are given archaeological clearance prior to setting the structure, removal of the structure should not result in any adverse impact to archaeological resources. This is consistent with the findings of the *Programmatic Environmental Assessment: Structure Removal Activities, Central and Western Gulf of Mexico Planning Areas* (USDI, MMS, 1987a).

Conclusion

The level of impact to historic sites in the Western Gulf as a result of the proposed action is expected to be low, with the exception of impacts to historic shipwrecks in the western portion of the WPA. Here, the potential for an interaction is uncertain, but could be very high. A study recently completed by Texas A&M University for MMS will help to define more specific ares where a high impact level is possible. The results of this study should be available for incorporation into Final EIS 123/125.

Cumulative Analysis

The specific impact producing factors that are considered in this analysis are trawling, sport diving at archaeological sites, commercial treasure hunting, hurricanes, dredging, platform and pipeline emplacement, oil spills, and chronic hydrocarbon inputs to coastal waters.

The most intensive areas of trawling in the Western Gulf are represented by the areas occupying the centers of abundance for white shrimp (Visual No. 2). Extensive trawling within these areas would probably only affect the upper three inches or so of sediment (NERBC, 1980). Any shipwreck site components within three inches of the present seabed probably would be affected by trawling activities. At many wreck sites, this zone would already be disturbed by natural forces and processes, and the upper three inches of sediment would only contain artifacts of low specific gravity that have lost all original context and have probably been abraded (Muckelroy, 1978). The effect of trawling, therefore, on most historic shipwreck sites would probably be very low.

Sport diving and commercial treasure hunting are significant factors in the loss of historic data from wreck sites. While commercial treasure hunters generally work at wreck sites that contain items with high monetary value, sport divers may collect souvenirs from all types of wrecks. The impact of these activities cannot be quantified because their extent is unknown. Assuming that any of the data that have been lost have been unique, the impact would be very high.

About one-third of the coast along the Western Gulf was hit by 16-20 tropical cyclones between the years 1901-1955 (DeWald, 1980). The other two-thirds had a slightly lower incidence of 11-15 tropical cyclones. In addition, five major hurricanes crossed the Western Gulf between the years 1954-1977. Shipwrecks in shallow waters are exposed to greatly intensified longshore currents and wave impacts during tropical storms (Clausen and Arnold, 1975). Under these conditions, artifacts of relatively low specific gravities (e.g., ceramics and glass) will likely disperse, leaving only the denser materials (iron, steel, ballast, and conglomerates) at the original site. Some of the information contained in the site would be lost in this process, but a significant amount of information would remain. Overall, a significant loss of data has probably occurred and will likely continue to occur in the future as a result of tropical storm activity. Tropical storms will also affect historic coastal sites located onshore when the storm makes landfall. Assuming that some of the data that would be lost are unique, this impact would be very high.

Channel dredging activities have a high potential for impacts to historic sites because the dredge operates at the entrances to the ports, harbors, and bays where many shipwrecks have occurred. In many areas, however, the COE now requires remote sensing surveys prior to dredging to minimize impacts. This requirement will reduce future impacts, but there is a high probability that in the past dredging impacts have been large, which would have reduced the existing shipwreck resource base.

Future OCS exploration and development activities are expected to result in the drilling of 3,240 exploration and delineation wells and 2,790 development wells, the installation of 190 platforms, and the laying of 2,305 miles of offshore pipelines. The archaeological survey reduces the potential for an interaction between an impact producing factor and an historic shipwreck by 25%-30% in the western part of the WPA. Since this does not significantly reduce the potential for an interaction, the potential for an impact is high to very high. In the eastern part of the WPA, the potential for an interaction would be reduced by 90%. Since this is a significant reduction in probability, there is a low probability that a damaging interaction between an impact producing factor and a shipwreck will occur. Therefore, the potential impact to historic shipwrecks in the western part of the WPA should be very low.

There are four projected pipeline landfalls in the Western Gulf under the cumulative scenario (Table IV-2). Since MMS does not permit pipelines in State waters, the archaeological resource protection requirements of the NHPA are not within MMS's jurisdiction. Other Federal agencies, such as the Corps of Engineers, are responsible for the protection of archaeological resources under the NHPA within coastal waters. The impacts that might occur to archaeological resources by pipeline construction within State waters should be mitigated, therefore, under the requirements of the NHPA.

Oil spills from a variety of sources (tanker spills at sea and in estuaries, pipeline leaks, well blowouts, etc.) could occur and contact coastal archaeological sites under the cumulative scenario. The impacts from oil contamination to historic sites are generally short-term and reversible, however, and the expected cumulative impacts from oil contamination are considered low.

Conclusion

The level of cumulative impacts on the historic archaeological resource base in the Western Gulf is estimated to be very high.

High Case Analysis

The higher level of offshore development projected for the High Case would increase the potential for an interaction between an impact producing factor and an historic shipwreck. Should an interaction occur, the potential exists for the loss of significant or unique archaeological information.

The archaeological survey reduces the potential for an interaction between an impact producing factor and an historic shipwreck by 25%-30% in the western portion of the WPA. This would not significantly reduce the potential for an interaction; therefore, in the western portion of the WPA, there would still be potential for a high to very high impact. In the eastern portion of the WPA, the potential for an interaction would be reduced by 90%. Since this is a sufficient reduction in probability, it can be assumed that little damaging interaction between an impact producing factor and an archaeological site would occur. Therefore, the impact to historic shipwrecks in the eastern portion of the WPA should be very low.

Should an oil spill contact a coastal historic site such as a fort or a lighthouse, the major impact would be visual due to oil contamination of the site and its environment. This impact would probably be temporary and reversible with no actual loss of information. Based on the criteria of significance outlined above, the impact to coastal historic sites from an oil spill should be very low.

Conclusion

The level of impact to historic sites in the Western Gulf as a result of the High Case is expected to be very low, with the exception of impacts to historic shipwrecks in the western portion of the WPA. Here, the potential for an interaction is uncertain, but if an interaction with a significant shipwreck occurs, the impact is estimated to be very high.

(b) Prehistoric

Base Case Analysis

Prehistoric sites that are anticipated to occur offshore include all the types of sites that occur onshore, such as shell middens, campsites, kill sites, and tool manufacturing areas. Two possible prehistoric sites have been located on the OCS as a result of an MMS-funded study (CEI, 1986). These possible sites occurred in association with the ancient Sabine River valley offshore western Louisiana and eastern Texas. The results of this study indicate that with the right set of geologic and environmental conditions, prehistoric sites on the OCS may have survived marine transgression and may be able to be located and evaluated through seismic and sedimentary analyses.

Prehistoric archaeological sites on the OCS are important because the information that they may provide on prehistoric human migrations, settlement patterns, subsistence strategies, and cultural contacts across now submerged landmasses cannot be obtained from terrestrial sites. The information contained in these sites would, therefore, be scientifically significant and probably unique.

Offshore development as a result of the proposed action could result in an interaction between a drilling rig, platform, pipeline, or anchors at an inundated prehistoric site. This direct physical contact with a site could destroy fragile artifacts or site features and could disturb the site context. The result would be the loss of archaeological data on prehistoric migrations, settlement patterns, subsistence strategies, and archaeological contacts for North America, Central America, South America, and the Caribbean.

Likely locations for archaeological sites can be delineated with high-resolution seismic data. Operators are required to conduct a remote sensing survey for unsurveyed lease blocks located landward of the Archaeological Zone 2 boundary because data of sufficient resolution are unavailable for most unleased areas of the CPA. The Federal Government's authority for archaeological resource management on the OCS is based in the requirements of the National Historic Preservation Act of 1966, as amended, Executive Order 11593, and the OCSLA, as amended (Section I.B.4.d).

The archaeological surveys are estimated to be 90% effective in allowing identification and avoidance of high probability areas for site occurrence. Since this provides a sufficient reduction in the potential for an interaction between an impact producing factor and a prehistoric archaeological site, it can be assumed that little damaging interaction would occur. Therefore, the survey would reduce the potential impact to prehistoric sites in the CPA to very low.

Onshore prehistoric archaeological resources include sites, structures, and objects such as shell middens, campsites, kill sites, tool manufacturing areas, ceremonial complexes, and earthworks. Currently unidentified onshore prehistoric sites would have to be assessed after discovery to determine the uniqueness or significance of the information that they contain. Sites already listed on the National Register of Historic Places, and those considered eligible for the Register (Visual No. 3), have already been evaluated as having the potential for making a unique or significant contribution to science. Of the presently unidentified coastal prehistoric sites that could be impacted by onshore development, some may contain unique information.

Onshore development as a result of the proposed action could result in direct physical contact between construction of new onshore facilities, or a pipeline landfall, and a previously unidentified prehistoric site. This direct physical contact with a prehistoric site could destroy fragile artifacts or site features and could disturb the site context. The result would be the loss of information on the prehistory of North America and the Gulf Coast Region. No new onshore facilities or pipeline landfalls, however, are projected as a result of the proposed action (Table IV-2). Therefore, there should be no expected impact to onshore prehistoric sites in the WPA from onshore development.

Should an oil spill contact a coastal prehistoric site, the potential for dating the site using C-14 would be destroyed. If diagnostic artifacts are present in the site, however, loss of C-14 dating potential may not constitute a loss of unique information. Previously unrecorded coastal sites could also experience an impact from oil spill cleanup operations. Cleanup equipment could destroy fragile artifacts or site features and could disturb the site context. The result would be the loss of information on the prehistory of North America and the Gulf Coast Region. Some of the coastal prehistoric sites that may be impacted by beach cleanup operations may contain unique information. The probability of a large spill occuring and contacting a barrier beach in the WPA is under 0.5%, except at Galveston Island/Bolivar Peninsula where the probability is 1% (Table IV-8). Furthermore, it is unlikely that a spill between 50 and 1,000 bbls will occur and contact the coast during the 34-year lease life (Section IV.B.2.). The expected impacts to coastal prehistoric sites from spilled oil is, therefore, expected to be very low.

All platform locations within Archaeological Zones 1 and 2 are given archaeological clearance prior to setting the structure; removal of the structure should not result in any adverse impact to archaeological resources. This is consistent with the findings of the *Programmatic Environmental Assessment: Structural Removal Activities, Central and Western Gulf of Mexico Planning Areas (USDI, MMS, 1987a).*

Conclusion

The level of impact to prehistoric sites in the Western Gulf as a result of the proposed action is expected to be very low.

Cumulative Analysis

The specific impact producing factors that are considered in this analysis are trawling; tropical storms; dredging; platform and pipeline emplacements; oil spills resulting from the proposed action, prior and future OCS leasing and the tankering of imported oil; and chronic hydrocarbon inputs to the marine environment.

Trawling activity in the WPA would only affect the upper three inches or so of sediment (NERBC, 1980). It is unlikely that this limited extent will affect any buried prehistoric sites.

About one-third of the coast along the Western Gulf has been hit by 16-20 tropical cyclones between the years 1901-1955 (DeWald, 1980). The other two-thirds had a slightly lower incidence of 11-15 tropical cyclones. In addition, five major hurricanes crossed the Western Gulf between the years 1954-1977. Based on these figures, it is reasonable to assume that approximately 10 storms will affect the Western Gulf over the next 30 years. These storms affect coastal prehistoric sites on barrier islands and beach fronts by erosion and by the reworking of sediments, which would either destroy or change the context of site components. Assuming that some of the data that will be lost will be unique, this impact could be high.

Dredging activities occur mostly at entrances to ports, harbors, and bays. These would also have been sites favored by prehistoric populations that depended on the sea and trade for subsistence. In many areas, the COE now requires remote sensing surveys prior to dredging to minimize such impacts.

Future OCS exploration and development activities are expected to result in the drilling of 2,600 exploration and delineation wells and 2,790 development wells, the installation of 190 platforms, and the laying of 2,305 miles of offshore pipelines. The archaeological surveys are expected to reduce by 90% the potential for an interaction between an impact producing activity and a prehistoric resource. Since this is a significant reduction in probability, there is a low probability that a damaging interaction will occur.

There is a high probability (63%, Table IV-8) that a large oil spill (1,000 bbls or greater) resulting from the proposed action, prior and future OCS leasing, and the tankering of imported oil could occur and contact coastal archaeological sites under the cumulative scenario (Section IV.B.2.). In addition, a spill between 50 and 1,000 bbls is assumed to occur and contact the coastline sometime during the 34-year lease life. This hydrocarbon contamination is much more significant in its potential impact to prehistoric resources than it was to historic resources. The most serious effect of oil contamination is the alteration of the carbon content of organic materials in coastal prehistoric sites. This contamination may result in erroneous C-14 dates and the possible loss of all dating potential for a site. Thus, the loss of significant, prehistoric site data could be very high.

Conclusion

The estimated level of cumulative impact on the prehistoric archaeological resource base in the Western Gulf is very high.

High Case Analysis

The higher level of offshore development projected for the High Case would increase the potential for an interaction between an impact producing factor and a prehistoric site. Should an interaction occur, the potential exists for the loss of significant or unique archaeological information.

The archaeological survey reduces the potential for an interaction between an impact producing factor and a prehistoric archaeological site by about 90%. Since this is a sufficient reduction in probability, it can be assumed that little damaging interaction between an impact producing factor and an archaeological site would occur. Therefore, the impact to prehistoric sites in the WPA should be very low.

Should an oil spill contact a coastal prehistoric site, the potential for dating the site using C-14 would be destroyed. However, if diagnostic artifacts are present in the site, loss of C-14 dating potential may not constitute a loss of unique information.

Previously unrecorded coastal sites may suffer direct physical impact from beach cleanup operations. Interaction of cleanup equipment with a site could destroy fragile artifacts or site features and could disturb the site context. The result would be the loss of information on the prehistory of North America and the Gulf Coast Region. Of the coastal prehistoric sites that may be impacted by beach cleanup operations, some may contain unique information. The chance of a large spill occurring and contacting archaeological sites is low (3% , Table IV-8). Therefore, the expected impact to coastal prehistoric sites from an oil spill would be very low.

Conclusion

The level of impact to prehistoric sites in the Western Gulf as a result of the High Case is expected to be very low.

Impact Summary under Alternative A

Under Alternative A, the following resources and impact levels are noted: sensitive coastal habitats, whales, birds associated with the coastal area, the comercial fishing industry, wetlands, and archaeological resources are very low; deepwater benthic communities (low density), water quality (coastal/nearshore and offshore), brown pelicans, sea turtles, marine mammals, and recreational beach use are low; live bottom areas, deepwater benthic communities (high density), and air quality are moderate; and topographic features is very high.

b. Impacts from Alternative B - Delete Biologically Sensitive Offshore Habitats

Impact Analysis

This deletion option, as described in Section II.B.2., would delete the 82 unleased blocks of the total 200 blocks (these blocks are listed in Appendix A) which are on or near enough to biologically sensitive areas of topographic features of the WPA so that activities resulting from the proposed action could have a high probability of impacting these biota. (There are 5,055 blocks to be offered in the Western Gulf.) The resource estimates for the proposed action would not be significantly reduced as a result of adopting this alternative. Therefore, the projected number of oil spills would also remain unchanged. Such a deletion would prevent any oil and gas activity whatsoever in the affected blocks (except for pipeline construction which could be regulated through the normal pipeline permitting procedures); thus, it would eliminate any impacts to the biota of the area from oil and gas activities conducted within the blocks. Essentially, the blocks which fall within 3 nmi of the 85 m isobath (4 nmi of the 100 m isobath at the East and West Flower Garden Banks) of the Category A banks and within 1,000 m of the Category C banks of the Western Gulf are considered potential sources of impact to biota of those banks which could be harmed by oil and gas activities. Deleting this small percentage of the Western Gulf area should result in a very large reduction of the potential impacts to these high value biological resources as compared with the proposal.

The biological resources of the topographic features are considered very sensitive to potential impacts due to oil and gas operations; thus, this deletion alternative is presented in order to fully protect these resources. The proposed biological stipulation discussed in Section II.B.1.c.(1), while reducing the risks to very low, would not remove all risk.

To the extent that deletion of these few blocks will reduce the oil and gas exploration and development activities of the proposed action and to the extent that the resources expected to be impacted by the proposed action (such as endangered species, commercial and recreational fisheries, water quality, etc.) are found in those blocks, the impacts to those resources will be similarly reduced. Thus, adoption of this alternative and offering 5,055 blocks with only a small percentage of the Western Gulf deleted (and no change in the resource estimates) would leave impacts to all resources other than the topographic features unchanged from the proposal (Table S-3).

Conclusion

Adoption of this alternative will reduce the impacts to the biota of the topographic features to very low (from the very high of the proposal). However, the proposed biological stipulation (Section II.B.1.c.(1)), if adopted, will also achieve this reduction. The impacts to all other resources will remain the same as in the proposal.

c. Impacts from Alternative C - No Action

Impact Analysis

All positive and negative impacts associated with the proposed action (as discussed in Section IV.D.2.a.) would be cancelled.

The opportunity would be foregone or postponed for development of the 0.10 billion bbls of oil and 1.48 tcf of gas in the Western Gulf. Development of alternative energy supplies for lost domestic production is discussed in Section IV.D.1.c.

Based on the resources estimated by MMS, Table IV-21 presents the energy equivalents that may be required from several alternative energy sources should this sale be permanently cancelled. For the purpose of clarity, this table has separately identified each potential alternative source of energy regarding substitution requirements. It is unlikely, however, that there would be a single choice between these alternative sources, but instead, some combined effort to further explore and develop many or all of these forms as a substitute for OCS oil and gas production. A detailed discussion of alternative energy resources is contained in Section IV.D.1.c.

Conclusion

If no action is taken on this proposed sale, all environmental impacts that are estimated to have occurred under the proposed action will be avoided. Adverse socioeconomic impacts are estimated to include a loss of employment opportunities, payroll revenues, and tax revenues.

d. Unavoidable Adverse Impacts of the Proposed Action

Sensitive Coastal Habitats: Accidents that result in spilled oil could require the removal of beach sand during oil spill cleanup activities, which could result in unavoidable adverse impacts. Likewise, if an oil spill contacted coastal wetlands, adverse impacts could be extremely high, killing an undetermined quantity of coastal wetlands, the effects of which may last up to 3 years.

Sensitive Offshore Habitats: Severe and perhaps permanent damage to the biota of the topographic features could result if a blowout or seafloor oil spill were to occur in proximity to a topographic feature. Low relief topographic features could experience increased sedimentation and turbidity from unshunted drilling discharges. In addition, the proposed action, without the biological stipulation, could result in potentially permanent destruction of the productive biological habitats of the topographic features due to mechanical damage from the unrestricted emplacement of rigs, platforms, and pipelines, and from the anchoring of industry vessels.

Water Quality: Normal offshore operations would have unavoidable effects to varying degrees on the quality of the surrounding water if the proposed action is implemented. Drilling, construction, and pipelaying could cause an increase in the turbidity of the affected waters for the duration of the activity periods, and, in the case of pipelines, could disturb settled pollutants. A turbidity plume, several hundred meters in length, could also be created by the discharge of drill cuttings and drilling fluids. This, however, would only affect water in the immediate vicinity of the rigs. The discharge of treated sewage from the rigs and structures could increase the levels of suspended solids, nutrients, chlorine, and BOD in a small area near the discharge points for a short period of time. Chronic spills from structures and the discharge of formation waters could result in increases of hydrocarbon levels and possibly trace metal concentrations in the water column. Overall, the effect could be the degradation of water quality around structures, although the extent of the impact would extend only from a few meters to a few tens of meters from the discharge site.

Unavoidable impacts to onshore water quality occurs as a result of runoff and effluent discharges from existing onshore infrastructure. Vessel traffic contributes to the degradation of impacted waterbodies through inputs of chronic oil leakage, treated sanitary and domestic waste, and contaminants known to exist in ship paints. Additional impacts could result from increased sewage due to population growth in isolated communities. Regulatory requirements of the State and Federal water authorities and some local jurisdictions would be applicable to point source discharges from support facilities such as refineries and marine terminals.

Air Quality: Unavoidable adverse impacts to air quality could occur onshore adjacent to crude oil refineries, gas processing plants and areas of concentrated OCS activities. Unavoidable short-term impacts to air quality could occur near catastrophic events (oil spills, blowouts with fire, blowouts without fire) due to evaporation and combustion. Mitigation of long-term effects would be accomplished through existing regulations. However, short-term effects from nonroutine catastrophic events (accidents) are uncontrollable.

Endangered and Threatened Species: Some injury or mortality to sea turtles could result from collision with OCS-related vessel traffic, seismic activities, and the use of explosives to remove offshore structures, caissons, and casings. Oil spills could result in some injury or mortality to sea turtles and brown pelicans.

Marine Mammals: Some injury or mortality to marine mammals could result from OCS-related oil spills (large and small), collision with offshore support vessels, structures removals, and/or seismic activities.

Coastal and Marine Birds: Some injury or mortality to individual and/or local populations of coastal and marine birds could result from OCS-related oil spills.

Commercial Fishing Industry: Of the various types of fishing gear in use in the OCS areas, trawls have the greatest chance for operational conflicts with oil and gas activities. Losses may, however, be compensated under the Fishermen's Contingency Fund or other legal routes. Trawl nets can be snagged on underwater stubs causing damage or loss of the nets. In addition, it is conceivable that snags could damage underwater production equipment or pipelines causing a spill of oil and gas. Because safety equipment is installed, which shuts in production when a loss of pressure occurs, the likelihood of a major spill resulting thereby is considered very small. Less frequently, large objects which were lost overboard from petroleum industry boats, pipeline lay barges, and structures are caught by fishing gear resulting in damage to the gear and/or its catch of fish; however, occurrence of this type of incident is low. Also, it is unlikely that commercial fishermen would harvest fish in the area of an oil spill, as spilled oil could coat or contaminate commercial fish species rendering them unmarketable. Other unavoidable adverse impacts include loss of fishing space caused by installation of unburied pipelines, rigs, structuress, or by other OCS-related structures. There could be some localized competition for shore facilities.

Major Shorefront Recreational Beaches: Even though existing regulations and OCS orders prohibit indiscriminate littering of the marine environment with trash, offshore oil and gas operations involving men, machines, equipment, and supplies may result in some littering of the ocean. Human nature and accidents associated with offshore operations can contribute some floatable debris to the ocean environment which may eventually come ashore on major recreational beaches. Likewise, accidents can lead to oil spills which are difficult to contain in the ocean; therefore, it may be unavoidable that some recreational beaches become temporarily soiled by weathered crude oil.

Archaeological Resources: As a result of the proposed action, unique or significant archaeological information could be lost. The archaeological survey significantly lowers the potential for this loss by identifying potential archaeological sites prior to lease development, thereby making avoidance or mitigation of impacts possible in most cases. In some cases (e.g., in areas of high sedimentation rates), survey techniques may not be effective at identifying a potential resource.

e. Irreversible and Irretrievable Commitment of Resources

Wetlands: An irreversible and irretrievable commitment of biological resources could occur where wetlands are impacted by frequent oil spills and chronic low level contamination with oil. Repeated contact with oil could destroy wetlands vegetation which results in soil erosion and land loss.

Construction and emplacement of onshore support infrastructure and pipelines in coastal wetlands could result in the permanent loss of coastal wetlands due to mechanical destruction of plants and due to land loss facilitated by saltwater intrusion followed by erosion of marsh soils.

Sensitive Offshore Habitats: An irreversible and irretrievable loss of biotic resources would occur in areas subjected to intensive development, particularly at the East and West Flower Garden Banks. Oil spills and chronic low level pollution can injure and kill organisms at virtually all trophic levels. Mortality of individual organisms can be expected to occur, and possibly reduction or even elimination of a few small or isolated populations. Section IV.D.2.a.(2) identifies the types of impacts which can occur and the resources which are particularly sensitive to adverse impacts resulting from the proposed action. Adverse impacts resulting from the proposed action, without the biological stipulation, could be very high and potentially permanent.

Commercial Fishing Industry: Structure removal by explosives causes mortality to commercial fish species. Fish kills comprised predominantly of red snapper have been observed after explosives are used to remove structures in the Gulf of Mexico. If structure removal by explosives is continued, it will adversely impact the commercial fishing industry proximate to the removal site. However, in view of the positive impact the presence of offshore platforms, acting as artificial reefs and Fish Attracting Devices, has on Gulf of Mexico commercial fishing (Section III.B.6.), continued structure removal, regardless of the technique used, will reverse this positive influence.

Archaeological Resources: Although the expected impact to archaeological resources as a result of the proposed action is uncertain, any interaction between an impact producing factor (drilling of exploratory, delineation, and development wells, placement of platforms, subsea completions, and pipeline installation) and a significant historic shipwreck or prehistoric site could destroy information contained in the site components and in their spatial distribution. This would be an irretrievable commitment of potentially unique archaeological data.

Local Employment, Income, and Population: The proposed action could result in the production of certain OCS-related goods and services. To the extent that resources would be drawn away from other uses, production of goods and services in other areas of other types could be foregone. Steel products, specialized manpower, and capital constitute required resources which may be scarce; use of these resources for OCS needs means that other opportunities for their use might have to be foregone. While these resources may be reclaimed over time, their use as a result of the proposed action could constitute an irreversible and irretrievable commitment of resources at a given point in time. To the extent that underemployed labor resources are used to fill new job opportunities, this would not constitute a cost to society in the form of foregone labor opportunities.

Oil and Gas Development: Leasing of the proposed blocks and subsequent development and extraction could represent an irreversible and irretrievable commitment of nonrenewable oil and gas resources. The estimated amount of resources expected to be recovered as a result of proposed lease Sale 125 is presented in Table IV-2. The energy and materials used to explore for and produce oil and gas, and maintain such operations, are nonrenewable resources that could be expended.

Loss of Human and Animal Life: OCS oil and gas exploration, development, production, and transportation is carried out under comprehensive, state-of-the-art, enforced regulatory procedures designed to ensure public safety and environmental protection. Notwithstanding, some loss of human and animal life is inevitable from unpredictable and unexpected acts of man and nature (unavoidable accidents, human error, and noncompliance, and adverse weather conditions). Some normal and required operations such as platform removal can result in the destruction of viable marine communities. Although the possibility exists that individual marine mammals, sea turtles, and fish can be injured or killed, there is unlikely to be a lasting effect on baseline marine populations.

f. Relationship Between the Short-term Use of Man's Environment and the Maintenance and Enhancement of Long-term Productivity

In this section, the short-term effects and uses of various components of the environment of the Western Gulf Sale 125 area are related to long-term effects and the maintenance and enhancement of long-term productivity. The effects of the proposed action would vary in kind, intensity, and duration, beginning with preparatory activities (seismic data collection and exploration drilling) of oil and gas development and ending when natural environmental balances might be restored.

In general, short-term refers to the useful lifetime of the proposal, but some even shorter term uses and effects are considered. Long-term refers to that time beyond the lifetime of the proposal. The producing life of the field development in the Western Gulf Sale 125 area has been estimated to be about 34 years, based on the Base Case resource estimate. In other words, short-term refers to the total duration of oil and gas exploration and production, whereas long-term refers to an indefinite period beyond the termination of oil and gas production. The definitions for short-term and long-term as used in this section differ from those used in Section IV.D.2.a.

Many of the effects discussed in Section IV are considered to be short-term (being greatest during the construction, exploration, and early production phases), which could be further reduced by the mitigative measures discussed in Section II.B.1.c.

The principal short-term use of the leased areas in the Gulf under the proposals would be for the production of an estimated 0.10 BBO and an estimated 1.48 tcf of natural gas.

This activity could temporarily interfere with recreation and tourism in the region in the event of a major oil spill (1,000 bbls or greater) occurring and contacting popular tourist beaches. The probability of such an event is 2% (Table IV-8).

The short-term recovery of hydrocarbons may have long-term impacts on offshore biologically sensitive areas (Sections IV.D.1.a.(2) and IV.D.2.a.(2)) or archaeological resources (Sections IV.D.1.a.(10) and IV.D.2.a.(10)).

The proposed leasing may also result in onshore development and population increases which may cause very short-term adverse impacts to local community infrastructure, particularly in areas of low population and minimal existing industrial infrastructure. However, these impacts should occur only in the very short term. A return to equilibrium could be quickly expected as population changes and industrial development are absorbed in expanded communities.

After the completion of oil and gas production, oil spills and their impacts would not occur, and the marine environment is generally expected to remain at or return to its normal long-term productivity levels. To date there has been no discernible decrease in long-term marine productivity in OCS areas where oil and gas have been produced for many years. In other areas which have experienced apparent increases in oil pollution, such as the North Sea, some long-term effects appear to have taken place. Populations of pelagic birds have decreased markedly in the North Sea in recent years--prior to the beginning of North Sea oil production. Until more reliable data become available, the long-term effects of the chronic and major spillage of hydrocarbons and other drilling related discharges cannot be accurately projected. In the absence of such data, it must be concluded that the possibility of decreased long-term productivity exists as a result of the proposed action.

The OCS development off Louisiana and Texas has supported recreational and commercial fishing activities. This has stimulated the manufacture and sale of larger private fishing vessels and special fishing and recreational equipment. Additionally commercial enterprises such as charter boats have become heavily dependent on offshore structures for satisfying recreational customers. This proposed action could increase these incidental benefits of offshore development. The platforms expected to result from the proposed action could help replace those currently being removed where production has terminated. As the incidence of offshore fishing and diving has gradually increased in the past three decades, platforms (the focus of much of that activity) will begin to gradually decline as mineral resources become depleted and as production platforms are removed. In order to maintain the long-term productivity of site-specific, artificial locations attractive to fishermen and divers, some means, such as proliferation of artificial reef development programs, may need to eventually replace platform removals.

Short-term environmental socioeconomic impacts may result from the proposed action, including possible short-term losses in productivity as a result of oil spills. Long-term adverse environmental impacts are not expected if the archaeological and biological stipulations are adopted as part of the proposed action. However, some risk remains due to the potential for accidents. Oil and gas reserves could be lowered. Few long-term productivity or environmental gains are expected as a result of this proposed action; the benefits of the proposed action are expected to be principally those associated with a medium-term increase in supplies of domestic oil and gas. While no reliable data exist to indicate long-term productivity losses as a result of OCS development, such losses are possible. However, to the extent that OCS development would replace imports of oil which would otherwise be required, such losses as a result of tanker-related oil spills may occur in the absence of this proposed action.

SECTION V

CONSULTATION AND COORDINATION

V

V. CONSULTATION AND COORDINATION

A. DEVELOPMENT OF THE PROPOSED ACTIONS

The Final OCS 5-Year Leasing Schedule authorizes two 1990 Gulf of Mexico lease sales covering the Central and Western Gulf of Mexico and proposes these sales to be held in March and August 1990, respectively. These offshore oil and gas lease proposals are analyzed in this document.

The Area Identification process was initiated on May 19, 1988, with the Federal Register publication of the Call/NOI. The Call covered all unleased blocks in the CPA and WPA with the exception of the following:

Western Gulf of Mexico (Sale 122)

- Blocks A-398 and A-375 in the High Island Area, East Addition, South Extension (West and East Flower Garden Banks, respectively)

There were 14 responses to the Call/NOI--7 from industry, 3 from Federal agencies, 2 from States, 1 from an environmental organization, and 1 from a private individual. These comments were used in the identification of the area to be offered for lease in proposed Sales 123 and 125 and in the development of the issues, alternatives, and mitigating measures addressed in the Draft EIS.

B. DEVELOPMENT OF THE DRAFT EIS

In order to fulfill the NEPA requirements and CEQ regulations, MMS followed scoping procedures for contacting and coordinating with Federal, State, and local governments; academic institutions; public interest groups; and concerned individuals throughout the development of this document. The scoping process utilized in determining the issues and concerns for the proposed 1990 Gulf of Mexico sales is discussed in Section I.B.2.

At the time of the Call and NOI, the formal scoping process for the proposed sales was initiated. Federal, State, and local governments, along with other interested parties, were requested to send written comments to the Region on the scope of the EIS. These are summarized below.

C. RESPONSES TO THE CALL FOR INFORMATION AND THE NOTICE OF INTENT TO PREPARE AN EIS

Environmentally oriented comments were received in response to the Call/NOI for proposed 1990 Central and Western Gulf of Mexico OCS Lease Sales 123 and 125. Comments were received from the U.S. Environmental Protection Agency, State of Alabama (Governor's Office), Louisiana Department of Natural Resources, State of Texas General Land Office, the Marine Mammal Commission (Federally appointed), the Mobile (Alabama) Audubon Society, and Mr. Brandt Mannchen.

The following is a summary of the environmentally oriented comments received in response to the Call and NOI for proposed 1990 Central and Western Gulf of Mexico OCS Lease Sales 123 and 125.

United States Environmental Protection Agency

1. The USEPA is concerned about the effects of oil and gas activities on biologically sensitive offshore habitats without protective stipulations.

2. The Agency feels there is an apparent lack of any proposed mitigation or protective stipulations for deepwater chemosynthetic benthic communities: so-called Bush Hill communities.

3. The USEPA expressed concern that there is a lack of a well-defined basis for drawing conclusions regarding the cumulative effects of offshore air emissions on onshore air quality, particularly ozone formation.

State of Alabama, Governor's Office

1. The State of Alabama supports additional studies of the ridge trends and pinnacles that occur in its offshore waters.

2. The State supports the stipulation that has been proposed in previous EIS's for the pinnacle trend area in offshore Alabama, and has a number of concerns and recommendations that include the following:

    a. show all new bathymetric data in offshore Alabama on areawide maps;

    b. photographic surveys and faunistic studies should be conducted on major pinnacles and topographic features; and

    c. postlease/development photodocumentation monitoring within one mile of a well should be required.

3. The State expressed concern about potential impacts of pipeline construction on coastal wetlands and live bottom areas.

State of Louisiana, Department of Natural Resources

The State of Louisiana has the same concerns as those expressed in past sales. The concerns are listed below.

1. Should economic conditions improve and a "boom" in OCS activity occur, the State would be concerned if new industry development or expansion took place in coastal wetlands.

2. Mineral-based drilling mud's "cleaning" research may affect the disposal problem on shore. An analysis of the benefits and/or adverse impacts is called for in the EIS.

3. Trash and debris from OCS activity continues to be a problem along the coastline and remains a concern.

4. Fisherman Compensation Claims may increase with the increase of platform removal in the next 20 years.

5. The EIS should expand the discussion of mitigation for activities occurring in high oil and gas production areas.

6. Economic concern was expressed for communities experiencing declining local economies due to less oil and gas activity.

7. There is a concern about environmental risks and geohazards that may result in the trend toward deepwater development.

State of Texas, General Land Office

1. The State of Texas is concerned about the impacts from oil spills on wetlands, beaches, fishery resources, birds, and other wildlife.

2. The State is concerned about the impacts of pipelines on barrier islands and coastal wetlands.

3. The State expresses an interest in establishing artificial reefs in Texas waters through the use of abandoned platforms.

4. The State of Texas is concerned about the accumulation of trash from offshore sources on beaches and urges MMS to institute regulations for Federal oil and gas lessees prohibiting the disposal of any refuse from vessels or platforms in Federal waters.

Marine Mammal Commission

1. The EIS should include more information on the distribution, abundance, and seasonal movement patterns of the bottlenose dolphin, the most common marine mammal species in the coastal waters of the Gulf of Mexico, in order to assess possible impacts on the dolphin from the proposed lease sales.

2. The importance of the south Texas coast as a summer habitat for manatees should be determined and possible oil and gas impacts on manatees in this area should be evaluated.

3. The EIS should include descriptions of the natural history, demographics, essential habitats, and diets of marine mammal species that could be affected by the proposed lease sales. The EIS should also include a detailed analysis of the cumulative effects of oil and gas and all other human activities on marine mammals.

4. Because available information is likely to be insufficient to identify all possible effects of oil and gas activities, the EIS should specify a monitoring program that would be implemented to verify the predicted effects of oil and gas activities on mammals and to ensure that any unforeseen effects are detected in time to permit steps to be taken to prevent impacts from reaching unacceptable levels.

The Mobile Audubon Society

1. Previous EIS's have improperly evaluated energy conservation and alternative energy sources as alternatives to developing new offshore oil and gas reserves.

2. The EIS needs more detailed and complete cumulative analyses on numerous topics, including the following:

    a. withdrawals of groundwater;

    b. endangered and threatened species;

    c. dumping of trash and drilling discharges; and

    d. air pollution.

Mr. Brandt Mannchen

1. The MMS must do a comprehensive analysis of other proposed actions, i.e., alternative energy and energy conservation strategies including reduced or no drilling replaced by other means of energy development--solar, wind, etc.

2. The MMS should present a balanced presentation concerning the effects of drilling muds, cuttings, produced waters, and other offshore discharges.

3. The MMS should expand the knowledge of chemosynthetic communities and should overprotect these communities.

D. DISTRIBUTION OF THE DRAFT EIS FOR REVIEW AND COMMENT

Copies of the Draft EIS were sent to the following public and private agencies and groups for their review and comment.

Federal Agencies

- Congress
  - Congressional Budget Office
    - House Committee on Merchant Marine and Fisheries
      - Subcommittee on Panama Canal and OCS
    - Senate Committee on Energy and Natural Resources
      - Subcommittee on Energy and Mineral Resources
- Department of Commerce
  - National Marine Fisheries Service
  - National Oceanic and Atmospheric Administration
    - Office of Ecology and Environmental Conservation
    - Office of Ocean and Coastal Management
- Department of Defense
  - Department of the Air Force
  - Department of the Army
    - Corps of Engineers
  - Department of the Navy
- Department of Energy
- Department of the Interior
  - Bureau of Mines
  - Fish and Wildlife Service
  - Geological Survey
  - Minerals Management Service
  - National Park Service
    - Gulf Island National Seashore
    - Office of Environmental Project Review
    - Padre Island National Seashore
- Department of State
- Department of Transportation
  - Coast Guard
  - Office of Pipeline Safety Regulations
- Environmental Protection Agency
- Marine Mammal Commission
- Nuclear Regulatory Commission

State and Local Agencies

- Alabama
  - Governor's Office
  - Alabama Department of Environmental Management
  - Alabama Department of Conservation and Natural Resources
  - Alabama Geological Survey
  - Alabama Highway Department
  - Alabama Historical Commission and SHPO

Alabama State Clearinghouse
Alabama State Oil and Gas Board
Dauphin Island Marine Laboratory
State Docks Department

Mississippi
Governor's Office
Bureau of Marine Resources
Mississippi Department of Archives and History
Mississippi Department of Natural Resources
Mississippi Department of Wildlife Conservation
Mississippi State Clearinghouse
State Oil and Gas Board

Louisiana
Governor's Office
Department of Culture, Recreation, and Tourism
Department of Environmental Quality
Department of Natural Resources
Department of Transportation and Development
Department of Urban and Community Affairs
Department of Wildlife and Fisheries
Louisiana Geological Survey
Louisiana State Archaeologist

Florida
Governor's Office
Executive Office of the Governor
Florida Department of Community Affairs
Florida Department of Environmental Regulation
Florida Department of Labor and Employment Security
Florida Department of Natural Resources
Florida Department of State
Florida State Clearinghouse
Florida State Historic Preservation Officer

Texas
Governor's Office
Bureau of Economic Geology
Texas A&M University
Texas Air Control Board
Texas Department of Highways and Public Transportation
Texas Employment Commission
Texas General Land Office
Texas Historical Commission
Texas Parks and Wildlife Department
Texas Railroad Commission
Texas State Clearinghouse
Texas Water Commission
Texas Water Development Board
The Attorney General of Texas

Other

Alaska Department of Game and Fish

Libraries

Alabama
- Auburn University Library
- City of Mobile Public Library
- City of Montgomery Public Library
- Dauphin Island Sea Lab Library
- Gulf Shores Public Library
- University of Alabama at Huntsville Library

Florida
- Charlotte Glades Regional Library
- Collier County Public Library
- Florida A&M University, Coleman Memorial Library
- Florida Atlantic University Library
- Lee County Library
- Leon County Public Library
- Marathon Public Library
- Northwest Regional Library System
- St. Petersburg Public Library
- Tampa-Hillsborough County Public Library
- University of Florida Library
- University of Miami Library
- University of South Florida Library
- West Florida Regional Library

Louisiana
- Calcasieu Parish Library
- Howard Tilton Memorial Library, Tulane University
- Lafayette Public Library
- Louisiana State University Library
- Louisiana Tech University Library
- New Orleans Public Library
- Nicholls State University Library

Mississippi
- Gunter Library
- Harrison County Public Library
- Jackson George Regional Library System

Texas
- Abilene Cristian University, Margaret and Herman Brown Library
- Austin Public Library
- Baylor University Library
- Brazoria County Library
- Dallas Public Library
- East Texas State University Library
- Houston Public Library
- Lamar University Library
- La Ratama Library

Rosenburg Library (Galveston)
Stephen F. Austin State University, Steen Library
Texas A&M University Library
Texas Southmost University Library
Texas State Library at Austin
Texas Technical University Law Library
University of Houston Library
University of Texas at Arlington Library
University of Texas at Dallas Library
University of Texas at El Paso Library
University of Texas Library
University of Texas at San Antonio Library

Academic Institutions

Colorado State University
Florida Institute of Oceanography
Florida Sea Grant
Gulf Coast Research Lab
Louisiana State University
Louisiana Universities Marine Consortium Council
Mississippi Sea Grant Advisory Service
Oregon State University
Swarthmore College
State University System of Florida
Texas A&M University
University of Wisconsin
Woods Hole Oceanographic Institute

Industrial Firms

Amoco Production Company
Atlantic Richfield
Chevron Inc.
Exxon Company, USA
Exxon Production Research Company
ERT Houston
Florida Petroleum Council
Louisiana Land and Exploration Co.
MAR, Inc.
Pennzoil
Placid Oil Co.
Rowan Companies, Inc.
Shell Offshore Inc.
Texaco
TXP Operating
Walter Oil and Gas

Groups and Individuals

Audubon Society, Southwest Florida
Apalachee Audubon Society
Audubon Society, Mississippi Coast
Audubon Society, Mobile Bay, Alabama

Audubon Society, New Orleans, Louisiana
Audubon Society, Sanibel, Florida
Audubon Society, Venice, Florida
Center for Environmental Health
Environmental Confederation of Southwest Florida
Environmental Information Center (Florida)
Fisheries Association, Mississippi Coast
Florida Conservation News
Florida Public Interest Research Group
Florida Wildlife Federation
Ft. Myers Beach Chamber of Commerce
Fowl River Protective Association, Inc.
Greenpeace
Gulf of Mexico Fishery Management Council
HEART
Izaak Walton League of America
League of Women Voters
Louisiana Environmental Professionals Association
Louisiana Nature Center
Louisiana Wildlife Biologist Association
Louisiana Wildlife Federation
LUMCON
Lyle St. Amant Marine Lab
MANSOTA 88
Mississippi Coast Fisheries Association
Mississippi Sea Grant Advisory Service
Mississippi Wildlife Federation
Natural Resources Defense Council, Inc.
Oystershell Alliance
Petroleum Information Corporation
Sarasota Audubon Society
Save Our Wetlands
Sierra Club, Florida Chapter
Sierra Club, Houston Chapter
Sierra Club, Lone Star Chapter
Sierra Club, Long Beach, Mississippi
Sierra Club, New Orleans Chapter
Southwest Culture Resources Center
Tampa Audubon Society
Texas Water Conservation Association

SECTION VI

BIBLIOGRAPHY AND SPECIAL REFERENCES

VI

VI. BIBLIOGRAPHY AND SPECIAL REFERENCES

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These references are available for review by the public in the Gulf of Mexico OCS Region's library. Most of these references may also be found in public or university libraries. The library will, upon request, provide assistance to anyone having difficulty locating any of these publications.

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SECTION VII

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VII

VII

VII. PREPARERS

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SECTION VIII

GLOSSARY

VIII

VIII. GLOSSARY

Aliphatic - Of or pertaining to any organic compound of hydrogen and carbon characterized by a straight chain of the carbon atoms; three subgroups of such compounds are alkanes, alkenes, and alkynes.

Analysis Area - An OCS subplanning area or other OCS area (i.e., Eastern subplanning area E-4x) plus the adjacent coastal subarea; e.g., Eastern Analysis Area E-3 is composed of the offshore Eastern subplanning area E-3 plus Eastern coastal subarea E-3.

Anticline - An upfold or arch of stratified rock in which the beds or layers bend downward in opposite directions from the crest or axis of the fold.

Aphotic zone - Zone in the sea where light is below 1% of the surface value, and thus will not support photosynthesis.

API gravity - A special function of relative density which is the inverse of the usual scientific specific gravity term. It actually expresses a function of volume per unit weight with a higher number indicating that the crude oil (or other petroleum material) contains a higher content of gasoline and other light components.

Areas of high marine productivity - Include such areas as open bays, estuaries, and sounds that are used by finfish and shellfish as nursery and/or spawning grounds and may contain oyster reefs; nearshore Gulf areas that are important harvest grounds for menhaden and industrial bottomfish and/or finfish and shellfish spawning grounds; and coral areas in the vicinity of the Florida Keys.

Aromatic - Applied to a class of organic compounds containing benzene rings or benzenoid structures.

Asphaltene - Any of the dark, solid constituents of crude oils which are soluble in carbon disulfide but insoluble in paraffin napthas.

Ballast treatment - Treatment of a tanker's ballast water, which is contaminated by residuals of the original tanker cargo.

Barrel - Equal to 42 gallons.

Base Case - An estimate of the resources assumed to be leased, developed, and produced, given that hydrocarbons exist in the area (i.e., a conditional estimate), and an estimate of the exploration, development, production, and transportation activities appropriate to that level of resources.

Basin - A depression of the earth in which sedimentary materials accumulate or have accumulated, usually characterized by continuous deposition over a long period of time; a broad area of earth beneath which the strata dip, usually from the sides toward the center.

Biological opinion - An appraisal from either FWS or NMFS evaluating the impact of a proposed activity on endangered and threatened species.

Block - A geographical area, as portrayed on an official MMS protraction diagram or leasing map, that contains approximately nine square miles (2,304 hectares or 5,760 acres).

Blowout - Refers to an uncontrollable flow of fluids from a wellhead or wellbore. Unless otherwise specified, a flow of fluids from a flowline is not considered a blowout as long as the wellhead control valves can be automatically or manually activated. If the wellhead control valves become inoperative, the flow is classified as a blowout.

Blowout preventer - A stack or an assembly of heavy-duty valves attached to the top of the casing to control well pressure.

Bottomland hardwoods - Plant community typical of seasonally flooded floodplains.

Bunker fuel - Heavy residual fuel oil used in ships' boilers and in large heating and generating plants.

Caprock - A disk-like plate over all or part of the top of most salt domes in the Gulf coast states, composed of anhydrite, gypsum, limestone, and occasionally sulfur. Caprock may also be a comparatively impervious stratum immediately overlying an oil- or gas-bearing rock in an anticline.

Central Planning Area - The sale area offshore Alabama, Mississippi, and Louisiana.

Cetacean - A marine mammal such as whales, dolphins, porpoises, and related forms.

Coastal subareas - Discrete analysis areas (consisting of several counties/parishes) within the larger offshore coastal areas.

Coastal waters - Those waters surrounding the continent which exert a measurable influence on uses of the land.

Coastal wetlands - Include forested and nonforested habitats, mangroves, and all marsh islands which are exposed to the Gulf of Mexico waters. Acreage and shoreline distances for these categories can be found on Visual No. 14. of Final EIS 94/98/102. Included in forested wetlands are hardwood hammocks, cypress-tupelogum swamps, and fluvial vegetation/bottomland hardwoods. Nonforested wetlands include fresh, brackish, and salt marshes. These areas directly contribute to the high biological productivity of coastal water by input of detritus and nutrients, by providing nursery and feeding areas for shellfish and finfish, by serving as habitat for many birds and other animals, and by providing waterfowl hunting and fur trapping.

Coastal zone - The coastal waters (including the lands therein and thereunder) and the adjacent shorelands (including the waters therein and thereunder), strongly influenced by each other and in proximity to the shorelines of the several coastal states, and includes islands, transitional and intertidal areas, salt marshes, wetlands, and beaches. The zone extends seaward to the outer limit of the United States territorial sea. The zone extends inland from the shorelines only the extent necessary to control shorelands, the uses of which have a direct and significant impact on the coastal waters. Excluded from the coastal zone are lands the use of which is by law subject to the discretion of or which is held in trust by the Federal Government, its officers, or agents.

Commingling - Bringing together the production from wells, leases, pools, and fields with production of other operators.

Completion - Conversion of a development well or an exploratory well into a production well of oil and/or gas.

Condensate - Liquid hydrocarbons produced with natural gas that are separated from the gas by cooling and various other means. Condensate generally has an API gravity of 50°-120° and is water-white, straw, or bluish in color.

Conditional resources - Assessment of oil or gas resources under the assumption that economically recoverable resources exist within the area of interest.

Continental margin - A zone separating the emergent continents from the deep sea bottom.

Continental shelf - A broad, gently sloping, shallow feature extending from the shore to the continental slope.

Continental slope - A relatively steep, narrow feature paralleling the continental shelf; the region in which the steepest descent to the ocean bottom occurs.

Contingency plan - A plan for possible offshore emergencies prepared and submitted by the oil or gas operator as part of the Plan of Development and Production.

Critical Habitat - Specific areas essential to the conservation of a protected species and may require special management considerations or protection.

Deferral - Action taken by the Secretary of the Interior at the time of the Area Identification to remove certain areas/blocks from the proposed sale. Deferred areas could receive environmental description in the EIS but are not assessed as alternatives.

Deletion Alternative - An option available to the Secretary of the Interior to alter the proposed action in Alternative A by deleting areas/blocks from the sale. This action would normally take place after completed analysis is available in the Final EIS.

Delineation well - A well which is drilled for the purpose of delineating a discovered oil or gas reservoir, thereby enabling the lessee to determine whether to proceed with development and production.

Designated environmental preservation areas - Gulf of Mexico shorefront areas which have been established for the quality and significance of their natural environments. They have been legislatively, administratively, or privately protected from the developmental influences of man and are managed solely for the preservation, understanding, and appreciation of their natural attributes. Included are National Parks and Preserves, National and State Wilderness Areas, National Marine and Estuarine Sanctuaries, National Landmarks, Wildlife Sanctuaries, Florida Aquatic Preserves, and Environmentally Endangered Lands.

Detritus - Particulate organic matter originating primarily from the physical breakdown of dead animal and plant tissue (may also include the breakdown of inorganic material).

Detritivores - Animals whose diet consists of detritus and the microbial fauna attached to detrital particles.

Development - Activities that take place following discovery of minerals in paying quantities, including geophysical activity, drilling, platform construction, and operation of all onshore support facilities; and that are for the purpose of ultimately producing the minerals discovered.

Development well - A well drilled to a known producing formation in a previously discovered field. To be distinguished from a wildcat, or exploratory well and from an offset well.

Development/production service base - A service base which is used in support of offshore development and production activity.

Diapir - A piercing fold; an anticlinal fold in which a mobile core, such as salt, has broken through the more brittle overlying rocks.

Dilution - The reduction in the concentration of dissolved or suspended substances by mixing with water.

Discharge - Something that is emitted; flow rate of a fluid at a given instant expressed as volume per unit of time.

Discovery - The initial find of significant quantities of fluid hydrocarbons on a given field on a given lease.

Dispersion - A distribution of finely divided particles in a medium.

Dome - A roughly symmetrical upfold, the beds dipping in all directions, more or less equally, from a point; any structural deformation characterized by local uplift approximately circular in outline, for example, the salt domes of Louisiana and Texas.

Drill ship - A self-propelled, self-contained vessel equipped with a derrick amidship for drilling wells in deepwater.

Drilling mud - A special mixture of clay, water, or refined oil, and chemical additives pumped downhole through the drill pipe and drill bit. The mud cools the rapidly rotating bit; lubricates the drill pipe as it turns in the well bore; carries rock cuttings to the surface; serves to keep the hole from crumbling or collapsing; and provides the weight or hydrostatic head to prevent extraneous fluids from entering the well bore and to control downhole pressures that may be encountered (drilling fluid).

Eastern Planning Area - The sale area offshore Florida and offshore Baldwin County, Alabama.

Economically recoverable resource estimate - An assessment of hydrocarbon potential that takes into account the physical and technological constraints on production and the influence of costs of exploration and development and market price on industry investment in OCS exploration and production.

Effluent - The liquid waste of sewage and industrial processing.

Endangered and threatened species - Those species identified in 43 FR 238 (December 11, 1978) and subsequent publications.

Environmental impact statement - A statement required by the National Environmental Policy Act of 1969 (NEPA) or similar State law in relation to any major action significantly affecting the environment; a NEPA document.

Estimated level of impact - To make a rough approximation of the quantity or extent; calculate approximately.

Estuary - Semienclosed coastal body of water which has a free connection with the open sea and within which seawater is measurably diluted with fresh water.

Eutrophic(ation) - A body of water rich in dissolved nutrients (as phosphates) but often shallow and seasonally deficient in oxygen.

Expected level of impact - Denotes the level of impact having the highest probability of occurring.

Exploration - The process of searching for minerals. Exploration activities include: (1) geophysical surveys where magnetic, gravity, seismic, or other systems are used to detect or infer the presence of such minerals and (2) any drilling, except development drilling, whether on or off known geological structures. Exploration also includes the drilling of a well in which a discovery of oil or natural gas in paying quantities is made and the drilling, after such a discovery, of any additional well that is needed to delineate a reservoir and to enable the lessee to determine whether to proceed with development and production.

Exploratory well - A well drilled in unproved or semi-proven territory for the purpose of ascertaining the presence underground of a commercial petroleum or natural gas deposit.

Exposed coastline - Shoreline areas that can be directly impacted by activities in OCS waters (Visual No. 14 of Final EIS 94/98/102). All of the shoreline not classified as unexposed is exposed.

Fault - A fracture in the earth's crust accompanied by a displacement of one side of the fracture with respect to the other.

Field - An area within which hydrocarbons have been concentrated and trapped in economically producible quantities in one or more structural or stratigraphically related reservoirs.

Florida hammocks - Areas of higher elevation than their surroundings and characterized by hardwood and/or palm vegetation.

Flowlines - Pipelines that move oil from a header system, tank platform, or other facility to a point of final metering, processing, and/or sale.

Gathering lines - Pipelines used to bring oil from production leases by separate lines to a central point, that is, a tank farm or a trunk pipeline.

Geochemical - Of or relating to the science dealing with the chemical composition of and the actual or possible chemical changes in the crust of the earth.

Geologic hazard - A feature or condition that, if unmitigated, may seriously jeopardize offshore oil and gas exploration and development activities. Mitigation may necessitate special engineering procedures or relocation of a well.

Geomorphology - The science of surface landforms and their interpretation on the basis of geology and climate.

Geophysical - Of or relating to the physics of the earth, especially the measurement and interpretation of geophysical properties of the rocks in an area.

Geophysical survey - The exploration of an area during which geophysical properties and relationships unique to the area are measured by one or more geophysical methods.

Habitat - A specific type of place that is occupied by an organism, a population, or a community.

Herbivores - Animals whose diet consists of plant material.

High density offshore shellfish areas - Include nearshore areas known to have the highest concentrations of commercially important shrimp, spiny lobster, and stone crab.

High Case - An estimate of a significantly higher level of resource recovery and attendant exploration and development activity that could result from higher leasing interest than estimated for the Base Case or that could result from the discoveries of larger oil and gas accumulations than estimated under the Base Case assumptions.

Hydrocarbon - Any of a large class of organic compounds containing primarily carbon and hydrogen, comprising paraffins, olefins, members of the acetylene series, alicyclic hydrocarbons, and aromatic hydrocarbons, and occurring in many cases in petroleum, natural gas, coal, and bitumens.

Impact - A measurable alteration or change in environmental conditions.

Incidental take - Takings that result from, but are not the purpose of, carrying out an otherwise lawful activity conducted by the Federal agency or applicant.

Industry infrastructure - The facilities associated with oil and gas development, e.g., refineries, gas processing plants, etc.

Jack-up rig - A barge-like, floating platform with legs at each corner than can be lowered to the sea bottom to raise the platform above the water.

Land segment - A subarea, usually consisting of one or more counties or parishes, within the coastal subarea.

Landfall - The site at which a marine pipeline comes to shore.

Land use - The function for which people employ an area of land.

Lay barge - A shallow-draft, barge-like vessel used in the construction and laying of underwater pipelines.

Lease - Any form of authorization which is issued under Section 8 or maintained under Section 6 of the Outer Continental Shelf Lands Act and which authorizes exploration for, and development and production of, minerals.

Lease sale - The competitive auction of leases granting companies or individuals the right to explore for and develop certain minerals within a defined period of time.

Lease term - For oil and gas leases, a period of either five years or up to ten years (when a longer period is necessary to encourage exploration and development in areas because of unusually deep water or other adverse conditions (see primary term)).

Lighter - A barge or small tanker used to move cargo from a large ship to port; also, to transport by lighter.

Major shorefront recreational beaches - Those frequently visited sandy areas along the shorefront exposed to the Gulf of Mexico which support a multiplicity of recreational activity, most of which is focused at the land-water interface. Included are National Seashores and other selected areas in the National Parks System, State Park and Recreational Areas, county and local parks, urban beachfronts, and private resort areas.

Major accidents - Includes spills of 10,000 gallons (238 bbls) or more and includes those blowouts, explosions, and fires which result in major structural damage or loss of life.

Marshes - Persistent emergent nonforested wetlands characterized by vegetation consisting predominantly of cordgrasses, rushes, and cattails.

Military warning area - An area established within which the public is warned that military activities take place.

Nepheloid - Layer or zone of water, usually near the bottom, where turbidity increases significantly due to increased content of suspended material.

Offloading - Another name for unloading; offloading refers more specifically to liquid cargo, crude oil, and refined products.

Offshore marine recreational fishing - Hook and line sport fishing from a boat seaward of the beach in the Gulf of Mexico for fun, food and occasional incidental profit, inclusive of spearfishing.

Oil spill - A sudden, unintentional, or accidental unplanned release of oil.

Operational discharge - A release of oil that is part of the routine operations of a function.

Order of magnitude - A range of magnitude extending from some value to ten times that value (example: a value larger by two orders of magnitude would be 100 times that value).

Organic matter - Material derived from living plant or animal organisms.

Outer Continental Shelf (OCS) - All submerged lands that comprise the continental margin adjacent to the United States and seaward of state offshore lands.

Penaeids - Chiefly warm water and tropical prawns belonging to the family Penaeidae.

Petroleum - An oily, flammable bituminous liquid that occurs in many places in the upper strata of the earth, either in seepages or in reservoirs; essentially a complex mixture of hydrocarbons of different types with small amounts of other substances; any of various substances (as natural gas or shale oil) similar in composition to petroleum.

Plan of Development and Production - A plan describing the specific work to be performed, including all development and production activities that the lessee(s) propose(s) to undertake during the time period covered by the plan and all actions to be undertaken up to and including the commencement of sustained production. The plan also includes descriptions of facilities and operations to be used, well locations, current geological and geophysical information, environmental safeguards, safety standards and features, time schedules, and other relevant information. Under 30 CFR 250.34-2, all lease operators are required to formulate and obtain approval of such plans by the Director of the Minerals Management Service before development and production activities commence.

Plan of Exploration - A plan based on available relevant information about a leased area that identified, to the maximum extent possible, the potential hydrocarbon accumulations and wells that the lessee(s) propose(s) to drill to evaluate the accumulations within the entire area of the lease(s) covered by the plan. Under 30 CFR 250.34-1, lease operators are required to formulate and obtain approval of such plans by the Director of Minerals Management Service before significant exploration activities may commence.

Plankton - Passively floating or weakly motile aquatic plants and animals.

Platform - A steel or concrete structure from which offshore development wells are drilled.

Porous - Containing void spaces that may be occupied by fluids.

Potable - Suitable for drinking.

Potential impact - The range of alterations or changes to environmental conditions that could be caused by a proposed action.

Primary production - Production of carbon by a plant through photosynthesis over a given period of time.

Primary term - The initial period of oil and gas leases, normally five years (see lease term).

Production - Activities that take place after the successful completion of any means for the removal of minerals, including such removal, field operations, transfer of minerals to shore, operation monitoring, maintenance, and workover drilling.

Production curve - A curve plotted to show the relation between quantities produced during definite consecutive time intervals.

Production schedule - A percentage distribution intended to show quantities of oil or gas produced over a consecutive time interval.

Production well - A well which is drilled for the purpose of producing oil or gas reserves. It is sometimes termed development well.

Province - An area throughout which geological conditions have been similar or that is characterized by particular structural, petrographic, or physiographic features.

Recoverable resource estimate - An assessment of oil and gas resources that takes into account the fact that physical and technological constraints dictate that only a portion of resources or reserves can be brought to the surface.

Refining - Fractional distillation, usually followed by other processing (for example, cracking).

Relief - The elevations or inequalities of a land surface.

Reserve estimate - An assessment of the portion of the identified oil or gas resource that can be economically extracted.

Reserves - Portion of the identified oil or gas resource that can be economically extracted.

Reservoir - An accumulation of hydrocarbons that is separated from any other such accumulation.

Rig - A structure used for drilling an oil or gas well.

Right-of-way - A legal right of passage, an easement; the specific area or route for which permission has been granted to place a pipeline, ancillary facilities, and for normal maintenance thereafter.

Risked, economically recoverable resource estimate - An assessment of oil or gas resources that has been modified to take into account: (1) physical and technological constraints on production; (2) the influence of the costs of exploration and development and market price on industry investment in OCS exploration and production; (3) and the uncertainty of the estimate and to account for the possibility that economically recoverable resources may not be found within the area of interest.

Saltwater intrusion - Phenomenon occurring when a body of salt water, because of its greater density, invades a body of fresh water. Occurs in either surface or groundwater sources.

Sciaenids - Fishes belonging to the croaker family (Sciaenidae).

Seagrass beds - More or less continuous mats of submerged rooted marine flowering vascular plants occurring in shallow tropical and temperate waters. Seagrass beds provide habitat, including breeding and feeding grounds, for adults and/or juveniles of many of the economically important shellfish and finfish. As such, this habitat type is especially sensitive to oil spill impacts.

Sediment - Material deposited (as by water, wind, or glacier) or a mass of deposited material.

Sedimentary rocks - Rock formed of mechanical, chemical, or organic sediment.

Seismic - Pertaining to, characteristic of, or produced by earthquakes or earth vibration; having to do with elastic waves in the earth.

Sensitive coastal habitats - Coastal habitats susceptible to damage from oil/gas-related OCS activities.

Sensitive offshore area - An area containing species, populations, communities, or assemblages of living resources, to which normal oil and gas exploration and development activities may cause irreparable damage, including interference with established ecological relationships.

Shunting - A method used in offshore oil and gas drilling activities where expended drilling cuttings and fluids are discharged near the ocean seafloor rather than at the surface, as is the case in normal offshore drilling operations.

Single point mooring (SPM) - Offshore anchoring and loading or unloading point connected to shore by an undersea pipeline. Used in areas where existing harbors are not deep enough for laden tankers.

Stratigraphic trap - A geologic feature that includes a reservoir, capable of holding oil or gas, that is formed from a change in the character or extent of the reservoir rock. Such a trap is harder because it is not dependent on structural closure and is thus not readily revealed by geological or geophysical surveys.

Subsea completion - A self-contained unit to carry men from a tender to the ocean bottom and enable them to install, repair, or adjust wellhead connections in a dry, normal atmosphere.

Subsea complex - A development well in which the assembly of valves, pipes, and fittings used to control the flow of oil or gas is located on or near the ocean floor.

Subsidence - A sinking of a part of the earth's crust.

Summary report - A document prepared by the Department of the Interior pursuant to 30 CFR 252.4 that is intended to inform affected state and local governments as to current OCS reserve estimates, projections of magnitude and timing of development, transportation planning, and general location and nature of nearshore and onshore facilities.

Supply boat - A vessel that ferries food, water, fuel, and drilling supplies and equipment to a rig and returns to land with refuse that cannot be disposed of at sea.

Sweet crude - Crude oil containing very little sulfur or sulfur compounds.

Sweet gas - Natural gas free of significant amounts of hydrogen sulfide (H_2S) when produced.

Taking - Harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct (including, but not inclusive of actions which induce stress, adversely impact critical habitat, or result in adverse secondary or cumulative impacts).

Total suspended solids (TSS) - The total content of suspended and dissolved solids in water.

Turbidity - Reduced water clarity resulting from the presence of suspended matter.

Undiscovered resources - Quantities of oil and gas estimated to exist outside known fields.

Unexposed coastline - That shoreline bordered by sheltered waters, particularly where an embayment creates a calmer sea state. Direct exchange of seawater is limited by coastal inlets of about two or less miles across (Visual No. 14 of Final EIS 94/98/102).

Unit - Administrative consolidation of OCS leases held by one or more companies but explored, developed, and/or produced as one lease by one operator for purposes of conservation, eliminating unnecessary operations, and/or maximizing resources recovered.

Vascular plants - Plants containing food and water conducting structures; higher plants which reproduce by seeds.

Vulnerability - The likelihood of being damaged by external influences. Vulnerability implies sensitivity of a system plus the risk of a damaging influence occurring.

Water test areas - Areas established within the Eastern Gulf where research, development, and the testing of military planes, ships, and weaponry takes place.

Weathering - The aging of oil due to its exposure to the atmosphere, causing marked alterations in its physical and chemical makeup.

Western Planning Area - The sale area offshore Texas.

Western subplanning area - A discrete subarea within the larger offshore planning area.

Wetlands - Areas periodically inundated or saturated by surface or groundwater and supporting predominantly vegetation typically adapted for life in saturated soil conditions.

SECTION IX

APPENDICES

IX

IX

Appendix A

Blocks Affected by the Topographic Features Stipulations in the Central and Western Gulf of Mexico

Central Gulf of Mexico

A total of 167 blocks in the Central Gulf would be affected by the topographic features stipulation, 102 of which are currently leased. The blocks affected, leasing status, and affected bank follow.

West Cameron, South Addition

Block	OCS-G No. (if leased)	Bank
569	9427	29 Fathom
570	5188	29 Fathom
589	5352	29 Fathom
590	9430	29 Fathom
591	6600	29 Fathom
592	6601	29 Fathom
611	6603	29 Fathom
612	2557	29 Fathom and MacNeil
613	3286	MacNeil
614	6604	MacNeil
633	2238	MacNeil
634		Rankin
635		Rankin
636		Bright
637	4097	Bright
638	2026	Bright
645	3973	Geyer
646	4411	Geyer
648	4268	Bright
649		Bright
650	6606	Bright
651		Bright
652	7636	Rankin and Bright
653	7637	Rankin
654	6607	Rankin
655		Rankin and Bright
656	6608	Bright
657		Bright
658	6609	Bright
659	6610	Bright
660	6611	Bright
661	6612	Bright
662		Bright and Rankin
663	6613	Rankin

East Cameron, South Addition

Block	OCS-G No. (if leased)	Bank
361		McGrail
362	6656	McGrail
363	6656	McGrail

East Cameron, South Addition (continued)

Block	OCS-G No. (if leased)	Bank
377	7676	McGrail
378	6660	McGrail
379	9486	McGrail

Vermilion, South Addition

Block	OCS-G No. (if leased)	Bank
284	9508	Sonnier
285		Sonnier
286		Sonnier
297		Sonnier
298		Sonnier
299	8674	Sonnier
300		Sonnier
303		Sonnier
304		Sonnier
305		Sonnier
306		Sonnier
317		Sonnier
318	4427	Sonnier
319		Sonnier
320	2087	Sonnier
361		Bouma
362		Bouma
363	9522	Bouma
369	2274	Bouma
370	2275	Bouma
371	9524	Bouma
372	2576	Bouma
382		Bouma and Rezak
383	7694	Bouma and Rezak
384	7695	Bouma
385		Bouma
386	2278	Bouma
387		McGrail
388		McGrail
389	6684	McGrail
390		McGrail
391	9528	McGrail and Bouma
392		Bouma
393	8677	Bouma and Rezak
394		Bouma and Rezak
395		Rezak
396		Rezak
403		Rezak
404	8678	Rezak
405		Rezak
406		Rezak and Bouma

Vermilion, South Addition (continued)

Block	OCS-G No. (if leased)	Bank
407		Bouma
408	9532	McGrail
409	9533	McGrail
410		McGrail
411		Sidner and Rezak
412	6685	Sidner and Rezak

South Marsh Island, South Addition

Block	OCS-G No. (if leased)	Bank
161	4809	Alderdice
162		Alderdice
163		Alderdice
169	9554	Alderdice
170		Alderdice
171	5467	Alderdice
172	4811	Alderdice
173	2887	Alderdice
176	5221	Alderdice
177		Alderdice
178	9555	Alderdice
179	9556	Alderdice
180	9557	Alderdice
185	9559	Alderdice and Parker
186	9560	Alderdice and Parker
187	7716	Alderdice and Parker
188		Alderdice and Parker
193	6694	Parker
194	6695	Parker
195		Parker
196	9562	Parker
197		Parker
200	7719	Parker
201	7720	Parker
202	7721	Parker
203		Parker
204		Parker

Eugene Island, South Addition

Block	OCS-G No. (if leased)	Bank
335	6723	Fishnet
355	7740	Fishnet
356		Fishnet
381	8703	Jakkula
382	9603	Jakkula

Eugene Island, South Addition (continued)

Block	OCS-G No. (if leased)	Bank
383		Jakkula
390	6730	Jakkula
391	6731	Jakkula
397		Jakkula

Ship Shoal, South Addition

Block	OCS-G No. (if leased)	Bank
325		Ewing
326		Ewing
327	6753	Ewing
328	6754	Ewing
329		Ewing
334		Ewing
335		Ewing
336	6756	Ewing
337	9633	Ewing
338		Ewing
339		Ewing
348		Ewing
349		Ewing
350	8716	Ewing
351	5580	Ewing
352		Ewing
353	6759	Ewing
356	5206	Ewing
357	5584	Ewing
358	5585	Ewing
359	5586	Ewing

South Timbalier, South Addition

Block	OCS-G No. (if leased)	Bank
314	5225	Diaphus
315	8728	Diaphus
316		Diaphus
317	5650	Diaphus

West Delta, South Addition

Block	OCS-G No. (if leased)	Bank
147		Sackett

West Delta, South Addition

Block	OCS-G No. (if leased)	Bank
148		Sackett

Green Canyon

Block	OCS-G No. (if leased)	Bank
4		Jakkula
5	6986	Jakkula
6	6987	Jakkula
7	6988	Jakkula
49	7002	Jakkula
50	7989	Jakkula
90		Sweet

Ewing Bank

Block	OCS-G No. (if leased)	Bank
903	5803	Ewing
932	6914	Jakkula
933	6914	Jakkula
944	5809	Ewing
945	6917	Ewing
947	5803	Ewing
975	6730	Jakkula
976	7918	Jakkula
977	6926	Jakkula

Mississippi Canyon

Block	OCS-G No. (if leased)	Bank
316		Sackett

Western Gulf of Mexico

A total of 200 blocks in the Western Gulf would be affected by the topographic features stipulation, 118 of which are currently leased. The blocks affected, leasing status, and the affected bank follow.

North Padre Island, East Addition

Block	OCS-G No. (if leased)	Bank
A-30	8965	Dream
A-31	8966	Dream
A-40	8967	Dream
A-41	8968	Dream
A-72		Blackfish Ridge
A-83	7159	Mysterious
A-84	7160	Mysterious

Mustang Island

Block	OCS-G No. (if leased)	Bank
A-3		North Hospital
A-4		North Hospital and Hospital
A-9		Southern
A-16	3011	Southern

Mustang Island, East Addition

Block	OCS-G No. (if leased)	Bank
A-54	10176	Small and Big Dunn Bars
A-61	10180	Baker
A-62	8086	Baker
A-86	8089	Baker and South Baker
A-87		Baker and South Baker
A-95	8090	South Baker
A-117	10184	Aransas and North Hospital
A-118	10185	Aransas
A-136	10188	Aransas, Hospital, and North Hospital
A-137	10189	Hospital

High Island, South Addition

Block	OCS-G No. (if leased)	Bank
A-446	2359	Claypile
A-447	2360	Claypile
A-448	2361	Claypile

High Island, South Addition (continued)

Block	OCS-G No. (if leased)	Bank
A-463	7337	Claypile
A-464		Claypile
A-465	9123	Claypile
A-486	6227	Stetson
A-487	4743	Stetson
A-488		Stetson
A-501		Stetson
A-502	7339	Stetson
A-503		Stetson
A-512	8567	Stetson
A-513	8568	Stetson
A-514		Stetson
A-527	9129	Stetson
A-528	8569	Stetson
A-529	9130	Stetson
A-534		32 Fathom
A-535		32 Fathom
A-573	2393	West Flower Garden
A-578		Applebaum
A-579		Applebaum
A-580		Applebaum
A-589		Applebaum
A-590	10304	Applebaum
A-591	7352	Applebaum
A-596	2722	West Flower Garden

High Island, East Addition, South Extension

Block	OCS-G No. (if leased)	Bank
A-311		29 Fathom
A-312	2409	29 Fathom
A-327	2418	29 Fathom
A-328		29 Fathom
A-329		29 Fathom
A-330	2421	29 Fathom
A-331		29 Fathom
A-332	2422	29 Fathom
A-340	2426	Coffee Lump
A-346		MacNeil
A-347	9151	MacNeil
A-348	9152	MacNeil
A-349	2743	MacNeil
A-350	2428	MacNeil
A-351	2429	MacNeil and East Flower Garden
A-352	9153	East Flower Garden and MacNeil
A-353	7362	East Flower Garden
A-354	9154	East Flower Garden

High Island, East Addition, South Extension (continued)

Block	OCS-G No. (if leased)	Bank
A-355	2745	East Flower Garden
A-358		Coffee Lump
A-359		Coffee Lump
A-360	8190	Coffee Lump
A-361	9155	Coffee Lump and West Flower Garden
A-362	7364	West Flower Garden
A-363	9156	West Flower Garden
A-364		East and West Flower Garden
A-365	2750	East Flower Garden
A-366	7365	East Flower Garden
A-367	7366	East Flower Garden
A-368	2433	East Flower Garden, Rankin, and MacNeil
A-369	2751	MacNeil and Rankin
A-370	2434	MacNeil and Rankin
A-371	9157	Rankin
A-372	9158	Rankin and MacNeil
A-373	7367	East Flower Garden, Rankin, and MacNeil
A-374		East Flower Garden
A-375		East Flower Garden
A-376	2754	East Flower Garden
A-377		East and West Flower Garden
A-378	8573	West Flower Garden
A-379	8574	West Flower Garden
A-380	7369	West Flower Garden
A-381	8192	West Flower Garden
A-382	2757	West Flower Garden
A-383		West Flower Garden
A-384	3316	West Flower Garden
A-385	10311	West Flower Garden
A-386	9159	East and West Flower Garden
A-387	9160	East Flower Garden
A-388		East Flower Garden
A-389	2759	East Flower Garden
A-390	9161	East Flower Garden and Rankin
A-391	9162	Rankin
A-392		Rankin
A-393	7370	Rankin
A-394		East Flower Garden
A-395	7371	East Flower Garden
A-396	7372	East and West Flower Garden

High Island, East Addition, South Extension (continued)

Block	OCS-G No. (if leased)	Bank
A-397	8575	West Flower Garden
A-398		West Flower Garden
A-399	7373	West Flower Garden
A-400	6263	West Flower Garden
A-401		West Flower Garden
A-402		West Flower Garden
A-403	6266	East Flower Garden

East Breaks

Block	OCS-G No. (if leased)	Bank
121		Applebaum
122		Applebaum
123	7388	Applebaum
124		Applebaum
165	6280	Applebaum
166		Applebaum
167	7392	Applebaum
168	7393	Applebaum
173		West Flower Garden
217	7399	West Flower Garden

Garden Banks

Block	OCS-G No. (if leased)	Bank
26	9197	McGrail
27	7431	McGrail
28	7432	McGrail
29	7433	McGrail
30		Rezak and Sidner
31		Rezak and Sidner
33		Rezak and Sidner
61		Geyer
62		Geyer
63		Geyer
70	9200	McGrail
71	9201	McGrail
72	7435	McGrail
73	7436	McGrail
74		Sidner
75		Sidner
76		Sidner
77		Sidner
81	9203	Parker

Garden Banks (continued)

Block	OCS-G No. (if leased)	Bank
82		Parker
83		Parker
84		Parker
85	10327	Parker
95	6332	East Flower Garden
96	6333	East Flower Garden
97	9204	East Flower Garden and Rankin
98	9204	Rankin
102	10328	Bright
103		Bright
104		Geyer
105	10329	Geyer
106	10330	Geyer
107		Geyer
108		Geyer and Elvers
109		Elvers
110		Elvers
119		Sidner
120		Sidner
121	10331	Sidner
126		Parker
127		Parker
128		Parker
133		West Flower Garden
134	8216	West Flower Garden
135		West Flower Garden
136		West Flower Garden
138		East Flower Garden
139	6347	East Flower Garden
140	6348	East Flower Garden
141	9210	Rankin
142	8217	Rankin
144		Bright
145		Bright
146		Bright
148		Geyer
149		Geyer
150		Geyer
151		Geyer
152	10333	Geyer and Elvers
153	8218	Elvers
154	9212	Elvers
155		Elvers
177		West Flower Garden
178		West Flower Garden
179		West Flower Garden
180	7444	West Flower Garden
192	3301	Geyer

Garden Banks (continued)

Block	OCS-G No. (if leased)	Bank
193	4130	Geyer
194		Geyer
195	10336	Geyer
196		Geyer and Elvers
197	7447	Elvers
198	10338	Elvers
237	2812	Geyer
238		Geyer
239		Geyer

Appendix B

Biological Opinion

United States Department of the Interior

TAKE PRIDE IN AMERICA

MINERALS MANAGEMENT SERVICE
WASHINGTON, DC 20240

DEC 23 1988

LE-2 BL

RECEIVED
JAN 10 1989
Minerals Management Service
Leasing & Environment

Christopher
Bartz
Maryuk
123/125
EIS Files

Mr. James W. Brennan
Assistant Administrator for Fisheries
National Marine Fisheries Service
Department of Commerce
Washington, D.C. 20235

Dear Mr. Brennan:

The Minerals Management Service (MMS) is preparing a draft Environmental Impact Statement for Oil and Gas Lease Sales 123 and 125 in the Gulf of Mexico (GOM). Lease Sale 123 will be comprised of blocks in the Central Gulf of Mexico Planning Area and is scheduled for March 1990. Lease Sale 125 encompasses blocks in the Western Gulf of Mexico Planning Area and is scheduled to be held in August 1990.

Under section 7(a)(2) of the Endangered Species Act (ESA), MMS hereby requests a formal consultation with the National Marine Fisheries Service (NMFS) on Lease Sales 123 and 125. The MMS staff at headquarters and in the GOM Region have discussed the consultation procedures with NMFS at a regional staff level and have agreed that a formal consultation meeting is unnecessary, and consultation can be performed most expeditiously by mail and telephone.

As with our request for formal consultation for Sales 118 and 122 submitted during 1988, MMS requests that the consultation includes all aspects of oil and gas exploration, development, production, and abandonment activities. However, we are excluding structure removal activities which use explosives from the request for formal consultation. Structure removals which require explosive charges are either being addressed on an individual basis under section 7 of the ESA, using the expedited procedures agreed to by our Agencies in November 1986, or are covered under the biological opinion dated July 25, 1988, issued for the Generic Consultation which embraces specific types of removals. Therefore, we are limiting the abandonment component of our request for consultation to nonexplosive removal of structures.

The MMS believes that the current biological opinion (Enclosure 1) issued on November 2, 1987, is up to date, is an effective environmental analysis, and includes the best available information on endangered and threatened species in the GOM Region. In addition to the information in the current biological opinion, we have provided the following documents for your information and to facilitate completion of the consultation.

(1) An environmental analysis of the effects of the MMS leasing program (Enclosure 2).

(2) Resource estimate reports and exploration and development reports for the Central and Western Gulf of Mexico Planning Areas (Enclosure 3).

(3) Oil spill occurrence probability estimates for Lease Sales 123 and 125 (Enclosure 4).

(4) The Oil Spill Risk Analysis model probabilities for Sale 123, organized by potentially affected resource and coastal land segments (Enclosure 5).

(5) The Oil Spill Risk Analysis model probabilities for Sale 125, organized by potentially affected resource and coastal land segments (Enclosure 6).

These documents will provide information on the anticipated procedures, execution, and effects of the proposed actions. To facilitate the completion of the consultation, we have provided copies of this memorandum and its enclosures directly to the Director, NMFS Southeast Regional Office.

To allow MMS to proceed with its programmatic responsibilities, we request that the biological opinions on the proposed actions be prepared in as timely a manner as possible. If you determine that there may be a potential "jeopardy" opinion in either action, we request that we be notified as early as possible, in accordance with 50 CFR 402.14(g)(5), so that our respective staffs can discuss the findings, as well as reasonable and prudent alternatives. This will ensure that the suggested alternatives are within our authority to control and implement and that they would be feasible, appropriate, and effective.

In addition, if conservation measures are considered appropriate to minimize the potential impacts of any incidental take anticipated to occur as a result of the actions, we request that we be notified as early as possible to enable our respective staffs to discuss these measures. The MMS believes that these discussions, if they are needed, would minimize or prevent subsequent difficulties or misunderstandings and greatly expedite an effective conclusion of the formal consultation. Our Washington headquarters and GOM staff members are prepared to meet with your endangered species staff as necessary to answer any questions they may have.

As always, it is understood that by providing us with a biological opinion for Lease Sales 123 and 125, you will not be relinquishing opportunities to reconsider and modify the biological opinion for future lease sales in these planning areas. It is our position that future lease sale proposals in a region or planning area provide an appropriate and recurring occasion for further consultation and that formal consultation will be initiated at that time. These formal proceedings will take place in addition to the ongoing informal consultations presently occurring throughout all phases of the Outer Continental Shelf leasing program.

3If you have any questions regarding this request, please contact Dr. Robert W. Middleton, Minerals Management Service, Mail Stop 644, 12203 Sunrise Valley Drive, Reston, Virginia 22091 (commercial telephone 703-648-7771; FTS: 959-7771).

Sincerely,

Robert E. Kallman
Director

6 Enclosures

cc: Dr. Charles Karnella
National Marine Fisheries Service
Department of Commerce
Washington, D.C. 20235

Dr. Terry Henwood
Southeast Regional Office
National Marine Fisheries Service
9450 Koger Boulevard
St. Petersburg, Florida 33702

bcc: AS/LM (2)
MMS General
Director's Chron
Official File (BEO) (GOM Sales 123 and 125; ENV 7-1.c) MS 644
AD/OMM
DAD/Leasing
DAD/Operations
RD, Gulf of Mexico Region
RS/LE, RS/FO, Gulf of Mexico Region
Pat Mangan, Gulf of Mexico Region
OEAD RF
Chief, BEO
Middleton/Turner/Pecora/Lewis
BEE/BES/BEM
Offshore Chron (1)/(2)
BEO RF
LMS:OEAD:MS644:BMiddleton:lm:12/14/88:9-6458-7771:c:lennis:123NMFS

United States Department of the Interior

TAKE PRIDE IN AMERICA

MINERALS MANAGEMENT SERVICE
WASHINGTON, DC 20240

B-6

JAN 27 1990

Memorandum

To: Director, U.S. Fish and Wildlife Service

From: Associate Director for Offshore Minerals Management

s/Thomas A. Readinger

Subject: Formal Consultation for Proposed Outer Continental Shelf (OCS) Oil and Gas Lease Sales 123 and 125 in the Gulf of Mexico (GOM) under the Endangered Species Act, Section 7

The Minerals Management Service (MMS) currently is preparing a draft Environmental Impact Statement for Oil and Gas Lease Sales 123 and 125 in the GOM. Lease Sale 123 will be comprised of blocks in the Central Gulf of Mexico Planning Area and is scheduled for March 1990. Lease Sale 125 encompasses blocks in the Western Gulf of Mexico Planning Area and is scheduled to be held in August 1990. Under section 7(a)(2) of the Endangered Species Act, MMS hereby requests a formal consultation with the U.S. Fish and Wildlife Service (FWS) on Lease Sales 123 and 125.

The MMS considers the biological opinion prepared for the Western Gulf of Mexico Planning Area (Sale 115) and dated June 19, 1987 (Attachment 1) to be up to date and effective. The FWS concurred with this biological opinion for the consultation for Sale 122 in the western GOM. However, MMS believes that the changes in the endangered and threatened species list; modification of the cumulative area designated as critical habitat; and advances in our knowledge of the biology, ecology, and potential impact on endangered or threatened species have established the need for a more current biological opinion in the Central Gulf of Mexico Planning Area. In addition, MMS requests that the scope of the biological opinion in the Central Gulf of Mexico Planning Area be expanded to include all phases of OCS oil and gas activity, including leasing, exploration, development, production, and abandonment.

The current (June 19, 1987) FWS biological opinion for the Western Gulf of Mexico Planning Area includes all phases of our program and has updated the biological information. However, the current (June 30, 1982) biological opinion available for the Central Gulf of Mexico Planning Area (Attachment 2) does not include all phases of the MMS program and is out of date for some biological information. This biological opinion was concurred with by FWS for the formal consultation requested by MMS for Sale 118 in the central GOM (Attachment 3).

My staff is available for a formal consultation meeting if that will assist you in initiating and expediting the consultation procedures. If you believe that a formal consultation meeting is appropriate, please have your staff contact us to schedule the meeting.

We have attached the following documents which will provide additional information for your use during the formal consultation.

(1) An environmental analysis of the potential effects of the proposed MMS lease sale (Attachment 4).

(2) Resource estimate reports and exploration and development reports for the Central and Western Gulf of Mexico Planning Areas (Attachment 5).

(3) The oil spill occurrence probability estimates for Lease Sales 123 and 125 (Attachment 6).

(4) The Oil Spill Risk Analysis model probabilities for Sale 123, organized by land segments and potentially affected resource (Attachment 7).

(5) The Oil Spill Risk Analysis model probabilities for Sale 125, organized by land segments and potentially affected resource (Attachment 8).

These documents will provide the needed information on the anticipated procedures, execution, and effects of the proposed actions for the formal consultation. To facilitate the initiation of the consultation, we have provided copies of this memorandum and its attachments directly to the FWS Regional Directors in Albuquerque, New Mexico, and Atlanta, Georgia. To allow MMS to proceed with its programmatic responsibilities, we respectfully request that you provide to MMS headquarters, the biological opinion on the proposed actions in as timely a manner as possible.

If you determine that there may be a potential "jeopardy" opinion in either action, we request that you inform us--in accordance with 50 CFR 402.14(g)(5)--so that our respective staffs can discuss the findings and any reasonable and prudent alternatives as early as possible during the consultation process. This will ensure that the suggested alternatives are within our authority to control and implement and that they would be feasible, appropriate, and effective.

In addition, if conservation measures are considered appropriate to minimize the potential impacts of any incidental take anticipated to occur as a result of the actions, we request that we be notified as early as possible to enable our respective staffs to discuss these measures. The MMS believes that these discussions, if they are needed, will minimize or prevent subsequent difficulties or misunderstandings and greatly expedite an effective closure of the formal consultation. Our Washington and GOM staff members are prepared to meet with your endangered species staff, as necessary, to answer any questions they may have.

As always, it is understood that by providing MMS with a biological opinion for Lease Sales 123 and 125, you will not be relinquishing opportunities to reconsider and modify the biological opinion for future lease sales in these planning areas. It is our position that future lease sale proposals in a region or planning area provide an appropriate and recurring occasion for further consultation and that formal consultation will be initiated at that time. These formal proceedings will take place in addition to the ongoing informal consultations presently occurring throughout all phases of the OCS leasing program.

If you have any questions regarding this request, please contact Dr. Robert W. Middleton, Minerals Management Service, Mail Stop 644, 12203 Sunrise Valley Drive, Reston, Virginia 22091 (commercial telephone 703-648-7771; FTS: 959-7771).

8 Attachments

cc: Regional Director
U.S. Fish and Wildlife Service
Attn: C. Robert Cooke, Jr.
75 Spring Street, SW.
Atlanta, Georgia 30303

Regional Director
U.S. Fish and Wildlife Service
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Official File (BEO) (GOM Sales 123, 125; ENV 7-1.c) MS 644
AD/OMM
DAD/Leasing
DAD/Operations
RD, Gulf of Mexico Region
RS/LE, RS/FO, Gulf of Mexico Region
[redacted]
OEAD RF
Chief, BEO
Middleton/Turner/Pecora/Lewis
BEE/BES/BEM
Offshore Chron (1)/(2)
BEO RF
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Appendix C

Resource Estimates Guidelines

ESTIMATES OF QUANTITIES OF UNDISCOVERED RESOURCES

I. Resource Assessment Methodology

Estimates of potential quantities of undiscovered oil and gas are vital to essential long-range national planning. The Federal Government's offshore oil and gas leasing program depends heavily on projections of the potential amounts of undiscovered hydrocarbon resources on the Outer Continental Shelf (OCS) and an estimate of those resources that may be technologically and economically recoverable. The pace of discovery and development of these resources affects national security, the economic health of a large sector of the economy, the balance of trade, and many other important national issues.

The Minerals Management Service (MMS) develops estimates of the undiscovered oil and gas resource base and economically recoverable undiscovered hydrocarbons in support of the OCS leasing program. These estimates are used in a number of public and internal documents related to leasing, such as sale-specific Environmental Impact Statements (EIS), Secretarial Issue Documents (SID), the Biennial Report to Congress, formulation of the 5-year leasing program, and technical publications.

The EIS's for specific lease sales and events such as the development of a 5-year leasing program use the estimates as a basis for analyzing potential environmental impacts of a proposed activity, e.g., oil spill risk analysis, sale alternatives and deferral options, or any other requirement for which the potential resources in specific areas may serve as the basis for evaluating potential actions. In the SID, estimates of the amounts and locations of potential resources are used to assist the Secretary of the Interior in balancing the economic benefits of development against the environmental consequences resulting from the leasing of offshore areas for petroleum exploration and development. Estimates provided in the Biennial Report to Congress may be used by the legislative branch and others for national strategic and economic planning purposes.

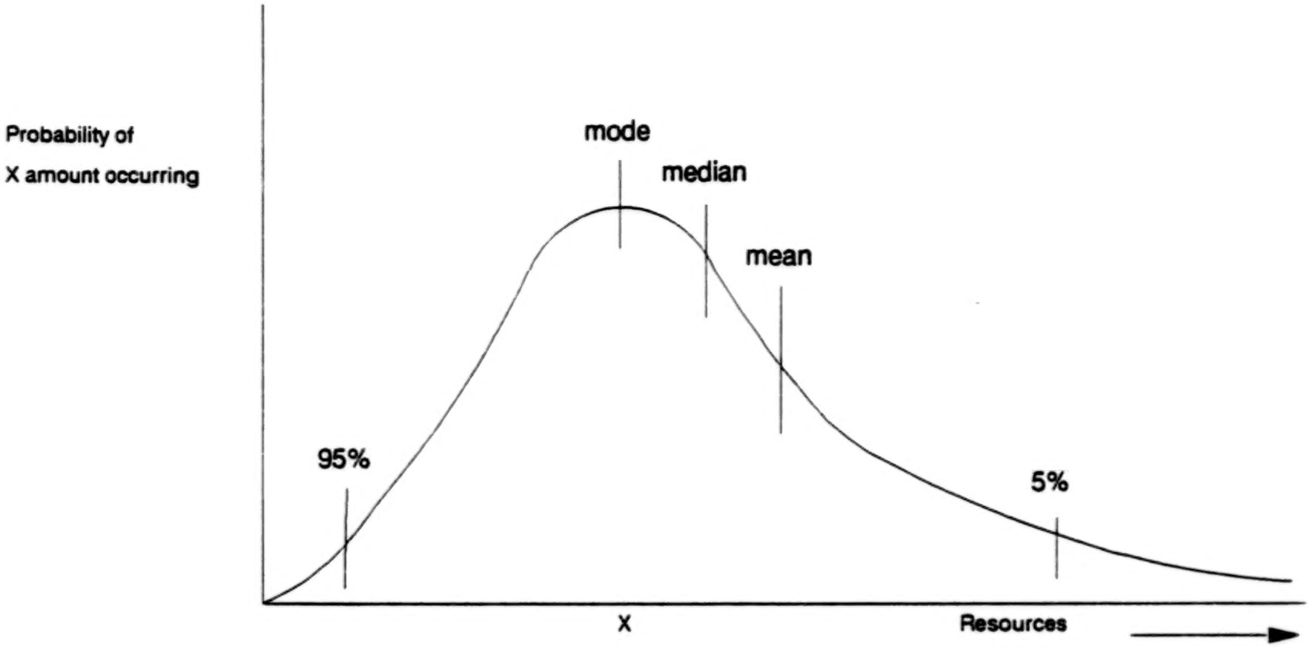
Estimating the economically recoverable amounts of oil and gas remaining to be discovered on the OCS is a difficult task because of the uncertainties inherent in the process. The actual existence of hydrocarbon accumulations is not known with certainty prior to exploratory drilling. The only information concerning the existence of a potential producing field is derived from inferences, extrapolations, and subjective judgments. Geophysical data provide clues as to the existence and location of possible traps (prospects) and their general dimensions, but geologic data on the quality of any potential reservoir rocks or source materials is usually absent. Generally, until drilling operations commence, no data will be available on the nature and distribution of included hydrocarbons, or indeed whether hydrocarbons are present at all. Obviously, an exact prediction of resource quantities under such circumstances is impossible because the uncertainties in the input data set translate directly to uncertainties in the estimates.

Two main types of undiscovered resource estimates are commonly used, each responding to different needs. *Conditional*, undiscovered resource estimates represent the amount of resources anticipated if a certain condition exists, the condition being that recoverable quantities of oil and/or gas are present in the area of study. In other words, if oil and/or gas are found to exist in an area, the conditional estimates represent the amount of hydrocarbons estimated to be ultimately recoverable. These estimates are used, for instance, to assess the potential environmental impacts in an area if leasing, exploration, development, and production were to occur; the condition that hydrocarbons exist must be assumed, otherwise impacts would not be a concern.

However, if the economic value of a resource is being considered, conditional estimates are not the appropriate measure. In these cases, such as the economic analysis prepared for sale-specific SID's, the resource estimates must incorporate the probability (or risk, which is often extremely high in frontier areas) that recoverable hydrocarbons may *not* be present in the entire area. The conditional estimates are modified by consideration of the probability that recoverable resources do not exist (that is, factoring in the risk) and are then said to be *risked* resource estimates.

Considering the uncertainty of geologic and engineering variables associated with hydrocarbon traps, resource estimates are usually presented as a range or distribution of values; reporting just one value lends a false sense of precision to the estimate. If a single estimate is required, the mean value of the distribution of possible values is the single best indicator of central tendency, since it reflects both the probability and magnitude of the estimates. The mean, also known as the expected value, is the arithmetic average of all values in the distribution. It is not the "most likely" estimate. The most likely estimate is a probability-weighted average called the mode. Another indicator is the median, which is the value that divides a probability distribution into two equal parts; it corresponds to the 50th percentile on a cumulative frequency distribution. The figure below depicts these three measures on a sample probability density curve. The 95 percent estimate shown on the graph indicates a low estimate having a

19-in-20 chance that the actual amount will be greater. The 5 percent value is a high estimate, with a 1-in-20 likelihood that the actual amount will be greater.



The resource estimation process used by the MMS to generate estimates under conditions of uncertainty, incorporates a computer program called PRESTO (*P*robabilistic *R*esource *EST*imates *O*ffshore). The MMS requires a model that provides a range of estimates, both conditional and risked.

The model is objective and utilizes a large geological and geophysical data base, not only from the offshore areas, which MMS has accumulated through regulation of the OCS oil and gas exploration and development activities, but also from onshore and offshore State lands. The results are reproducible and revisable. This allows new data or new interpretations to have a quantifiable effect on the resource estimates. Results are presented as ranges of values rather than as single-point estimates, so that useful limits can be provided for planning purposes. The model is also functional under a wide range of uncertainty since our knowledge of potential offshore petroleum provinces varies from considerable to practically none.

The current PRESTO model is in its third generation and incorporates many new, state-of-the-art enhancements. The program uses the types of geologic and geophysical data normally used by the oil industry to locate and define potential hydrocarbon-bearing geologic features. These data are analyzed, interpreted, and eventually refined to a set of input values, which numerically model all potential prospects in the study area.

Since these values are rarely exactly known, uncertainty is accounted for by range-of-values estimation, i.e., the inputs for variables can be entered as distributions over an appropriate range of possible values. The results are also presented as ranges of possible values with associated probabilities of occurrence. The variables used to define prospects and their resource potential are:

(1) areal extent (acres);

(2) zone pay thickness (feet);

(3) oil recovery factor (stock tank barrels/acre-feet);

(4) gas recovery factor (thousand cubic feet/acre-feet);

(5) proportion (PROP) of the zone pay thickness consisting of gas;

(6) solution gas-to-oil ratio (standard cubic feet/stock tank barrel); and

(7) condensate yield (stock tank barrels/million cubic feet of gas).

Dependencies among these input variables can be specified where appropriate. Two other zone properties that may be specified are (1) probability of all oil (OPROB) and (2) probability of all gas (GPROB) for each zone.

Before calculating resources, the model first determines if hydrocarbons are present. Next it determines whether a reservoir contains all oil, all gas, or both (by using OPROB, GPROB, and PROP). PRESTO then calculates volumes of oil, associated and nonassociated gas, condensate and solution gas, as appropriate, for all hydrocarbon-bearing prospects on each trial by the following equations:

(1) volume of oil, barrels = (acres) x (thickness) x (1-PROP) x (oil recovery factor);

(2) volume of nonassociated and associated gas, million cubic feet = (acres) x (thickness) x (PROP) x (gas recovery factor) x (0.001);

(3) volume of condensate, barrels = (condensate yield) x (nonassociated and associated gas); and

(4) volume of solution gas, thousand cubic feet = (gas-to-oil ratio) x (oil, barrels) x (0.001).

Using the above set of inputs as the basis for estimates of resource volumes, the program uses sophisticated statistical sampling techniques to calculate resources. Since each input can be represented by a distribution of values, one point on the distribution for each variable is randomly sampled and the selected values are entered into the volumetric equations to solve for resource amounts. This process is called a "drilling simulation trial" or "pass" and can be repeated as many as 10,000 times. On each of these trials, the model simulates a state of nature by "discovering" which prospects will be hydrocarbon-bearing by using input risks to simulate drilling of each prospect.

The model uses a four-level risk assessment (zone, prospect, basin (or play), and area (or basin)) to determine the number of trials in that a prospect or zone contributes to the total. The evaluator must enter risk values that measure the probability that the prospect or zones within a prospect will be dry and the overall probability that the basin (and area) may be dry.

Additional estimates of minimum economic field size for each prospect and minimum economic basin and area reserves (in barrels of oil equivalent (BOE)) are required to determine the portion of the undiscovered resource base that is economically recoverable. Minimum economic field sizes are calculated exogenously through use of a discounted cash flow (DCF) model. They represent the smallest resource amount that would balance development and operating costs (including transportation costs for the gathering system) for a prospect and yield a minimum rate of return. The minimum economic field size is tailored to the prospect, considering factors such as water depth, distance from shore, depth to the potential pay horizon, and current and projected economic conditions.

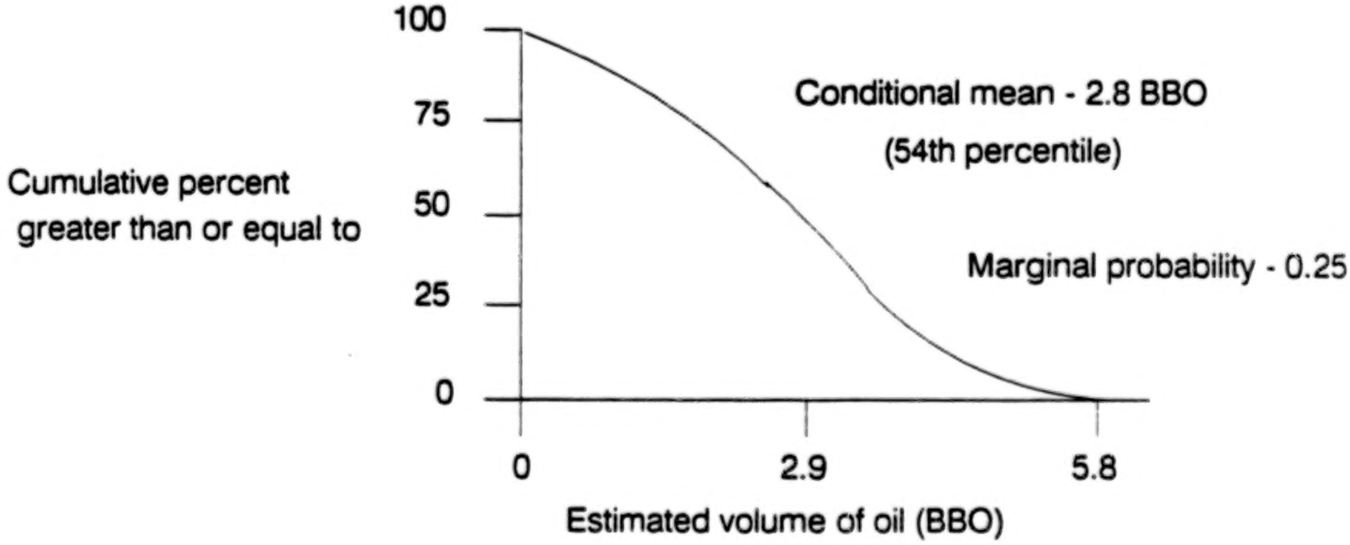
PRESTO develops estimates of economically recoverable resources on a trial by comparing the calculated resource volumes of each successful prospect to the minimum economic field size values provided by the user. The gas volumes calculated for a prospect are converted to a volume of oil equivalent on the basis of energy or economic equivalency and then added to the oil volume to yield a total BOE for the prospect. If the calculated prospect resource volume in BOE exceeds the minimum economic field size, the prospect is considered to be economically viable and its resources contribute to the total. If the calculated prospect resources are less than the minimum economic field size, then the prospect is considered noncommercial and its resources are set equal to zero for that trial. Resource amounts greater than the minimum economic field size for prospects within a basin are aggregated on each trial and compared to a minimum economic basin reserve. The minimum economic basin reserve, also calculated exogenously, is the minimum amount of resources necessary to justify a regional production infrastructure in a basin. Finally, resource amounts for all basins in an area on a given trial are compared to a minimum economic area reserve to determine whether enough resources are present to justify production facilities for the area. This feature is more appropriate for frontier areas than for mature areas with an existing infrastructure.

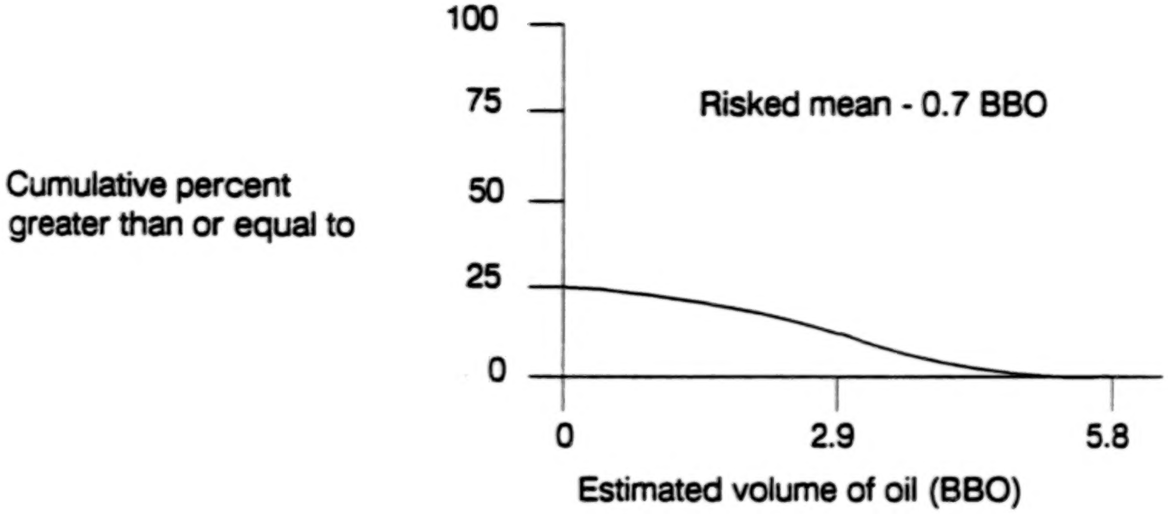
When the specified number of trials is completed for either the undiscovered resource base or economically recoverable estimates, the solutions of each trial are sorted and ranked, and the results are defined by distributions of solutions. Thus, the full range of possible volumetric solutions is represented by a single curve with each point on the distribution having an equal probability of occurrence. PRESTO outputs include both conditional and risked distributions. Since the output of PRESTO is a distribution of resource estimates, for convenience, the results are usually reported using only the mean value and the 5th and 95th percentiles. The 5th percentile can be considered a high case where there is a 5 percent chance of that amount or more occurring the 95th as a low case where there is a 95 percent chance of that amount or more occurring; the mean is the average value of all trials.

Conditional resource estimates are constrained by a number of statistical caveats, which are not intuitive. PRESTO calculates planning area resource estimates (or any subset such as an alternative sale configuration) by statistically aggregating the estimates of resources in each individual prospect. It does not follow, however, that the total planning area estimate is the arithmetic sum of the prospect estimates. This is because each prospect has a different condition (i.e., the marginal probability of hydrocarbon occurrence in the prospect). Prospect resources can be aggregated to planning area totals only by rerunning the program using all prospect data and making any required risk adjustments.

An important number associated with conditional estimates is the marginal probability. The condition is quantified by assigning it a numerical value (the marginal probability (MP)). The MP is a measure of the probability that hydrocarbons exist in an area and is represented as a decimal fraction. (For economically recoverable resources, the MP is a measure of the probability that *commercial* hydrocarbons exist in the area.) An MP of 1.00 indicates certainty of hydrocarbon occurrence in the area; an MP of zero indicates no chance whatsoever. The MP applies to the entire conditional distribution. As an example, consider an area having an MP equal to 0.25. This means that the area has a 25 percent chance of containing a hydrocarbon accumulation. If hydrocarbons *do* exist, then the conditional distribution represents the range of possible values. By removing the condition and incorporating the risk that the entire area may be barren of hydrocarbons, the estimates are said to be risked.

The following graphs illustrate conditional and risked resource distributions. Cumulative percentages are given on the vertical axis and oil volumes on the horizontal axis. The conditional curve has a corresponding MP of 0.25 and if hydrocarbons do exist, the conditional curve displays the calculated range of values. It can be seen on the conditional curve that the 50th percentile corresponds to 2.9 billion bbls of oil (BBO), i.e., there is a 50 percent probability that *at least* 2.9 BBO will be found *if* there are accumulations of oil present in the area (the mean or average value is 2.8 BBO, which corresponds to the 54th percentile in this case). The graphs below show the risked distribution of estimates. Note that the risked mean estimate is only 0.7 BBO (0.25 x 2.8), reflecting the low probability of success in this hypothetical area. The risked curve also shows that the chance of resource amounts being greater than or equal to zero is 25 percent (corresponding to the MP); there is a 75 percent chance the area is dry.





The conditional mean multiplied by the MP yields the risked mean, i.e., the average value factoring in the potential risk of no hydrocarbons existing in the area. However, this is statistically valid only for the mean value; the 5th and 95th percentiles cannot be multiplied by the MP for risked 5th and 95th percentiles. (The 5th and 95th percentiles on the conditional distribution, when multiplied by the marginal probability, will correspond to different percentiles on the risked distribution.)

The *risked mean* values can be added or subtracted. However, conditional means are not additive; conditional or risked percentile estimates (such as the 5th and 95th percentile estimates) cannot be added or subtracted. Risked mean resource values are most useful in comparing different areas for ranking purposes. However, as mentioned earlier, it is the conditional and not risked mean that is the amount anticipated if recoverable (or commercial) quantities of oil and gas occur in nature. The following example illustrates the essential difference between the two types of estimates and the need to consider both in making informed judgments and decisions. Two areas have been assessed, resulting in very different conditional mean resource levels and marginal probabilities.

	Conditional Mean (million bbls)	MP	Risked Mean (million bbls)
Area A	1,000	0.10	100
Area B	125	0.80	100

The risked mean values calculated for both areas are the same. However, Area A has a larger potential (eight times larger than Area B), with only a small chance (10 percent) of hydrocarbons existing in the area. If Area B contains hydrocarbons, the average amount anticipated is much smaller, but the chance of hydrocarbons existing in the area is greater (80 percent).

The distinction between conditional and risked results is further illustrated by the following example. The undiscovered resource base for a fictitious OCS basin is estimated to be between 1 and 7 BBO, with an average of 3 BBO *if oil is present in the basin*. However, it is estimated that there is only a 25 percent chance that this condition will be met (oil present in the basin). In other words, if there were 100 basins in the world similar to this fictitious basin, 75 would be dry and 25 would contain oil. The 25 basins containing oil would each have between 1 and 7 BBO, with the average size being 3 BBO. The average amount found in the 100 basins would be reported as 750 million bbls. This is the "risked mean" estimate. Therefore, based on current geologic, engineering, and economic knowledge, if this one fictitious basin is fully explored and oil is found, the amount found will be between 1 and 7 BBO, with an average value of 3 BBO. There is, however, only a 25 percent chance of oil being present, so the risked mean estimate is reported at 750 million bbls. In actuality, the amount found (if our models are correct) would be either zero or between 1 and 7 BBO and not the risked mean estimate of 750 million bbls.

II. Categories of Resource Estimates

Various categories of undiscovered resource estimates, each responding to a different question or need, can be developed using the models and methodologies described above. These estimates can be derived from a baseline data set comprised of all prospects in the area. These resource estimates form a nested hierarchy, where each estimate is a subset of previous estimates.

Geologic Province
(Conventionally Recoverable)
|
Planning Area Estimate
(Economically Recoverable)
|
Sale Area Estimate
(Economically Recoverable)
|
Economically Recoverable
Resources Assumed to be
Leased Due to Sale

Geologic Province Estimates are the top tier of undiscovered resource estimates. These estimates were based fundamentally upon analysis and review of the province petroleum geology, exploration history, play analysis, finding rate studies, and structural analyses.

The *conventionally recoverable* estimates include the quantities of oil and gas resources in undiscovered accumulations analogous to those in existing fields producible with current recovery technology and efficiency, in excess of 1 million bbls of oil equivalent (BOE), but without reference to economic viability. These estimates involve statistical projections based upon large-scale geologic observations in entities such as basins and provinces, and as such may not be directly translatable to administrative regions such as planning areas.

For the Gulf of Mexico, the undiscovered conventionally recoverable resource estimates are divided into two provinces--Cenozoic and Mesozoic. The Western and Central Planning Areas are almost entirely in the Cenozoic province. The Cenozoic and Mesozoic Province estimates for the entire Gulf of Mexico are shown in the following chart:

	Oil (BBO)	Gas (tcf)
Conditional		
95th Percentile	2.77	36.01
Mean	5.64	64.33
5th Percentile	9.88	103.65
Marginal Probability = 1.00		
Risked		
95th Percentile	2.77	36.01
Mean	5.64	64.33
5th Percentile	9.88	103.65

Planning Area Estimates are for policy guidance and as such, they are broad and all encompassing in nature. They are used, for example, to develop the 5-year leasing program and the Biennial Report to Congress (Section 606, OCS Lands Act). These estimates include both prospects identified through interpretation of geologic and geophysical data and prospects postulated by the extrapolation of geologic trends into areas having scant data.

They also include adjustments for the fact that current exploration tools and analyses are not perfect in identifying all potential accumulations.

Planning area estimates that are described as *economically recoverable* include resources only from those prospects that are of sufficient size to be economically producible and marketable, based on current and projected economic conditions and foreseeable technological trends.

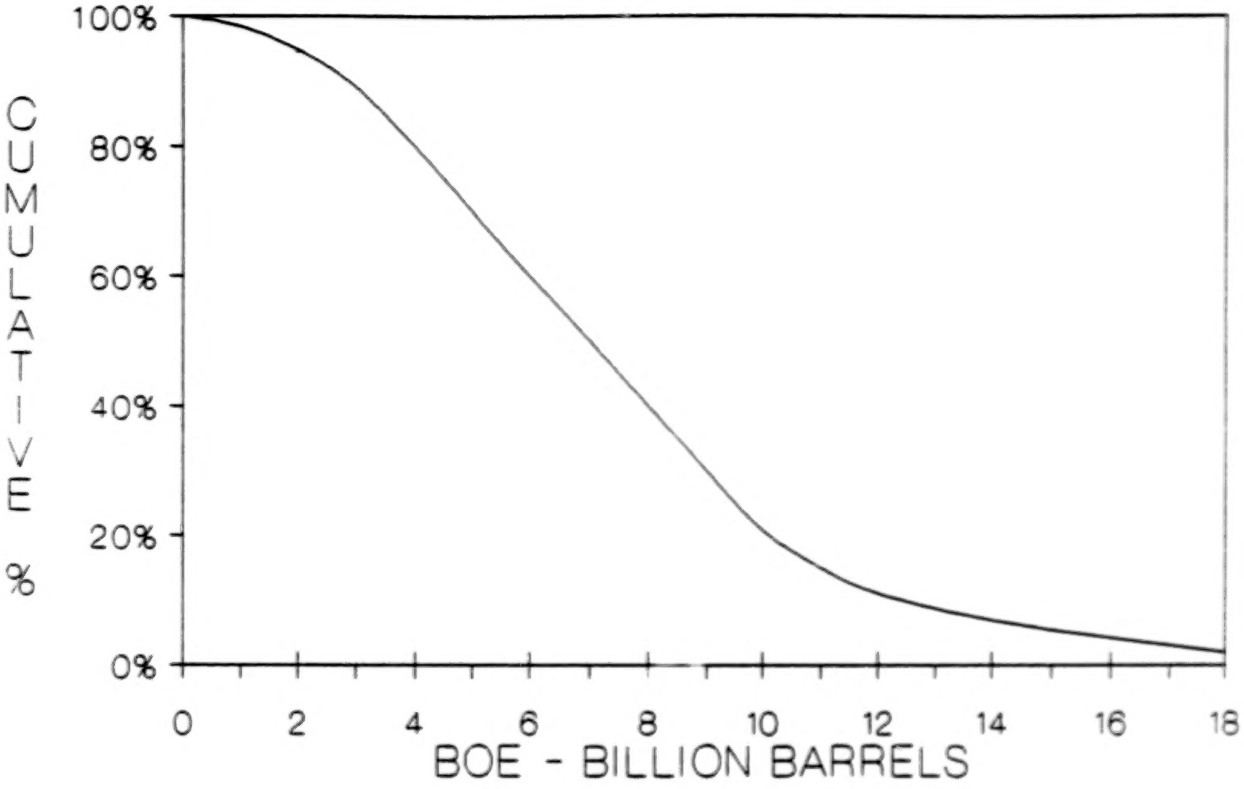
For the Central Gulf, the economically recoverable estimates are shown in the following chart:

	Oil (BBO)	Gas (tcf)
Conditional		
95th Percentile	0.69	7.24
Mean	2.76	25.95
5th Percentile	5.51	50.86
Marginal Probability = 1.00		
Risked		
95th Percentile	0.69	7.24
Mean	2.76	25.95
5th Percentile	5.51	50.86

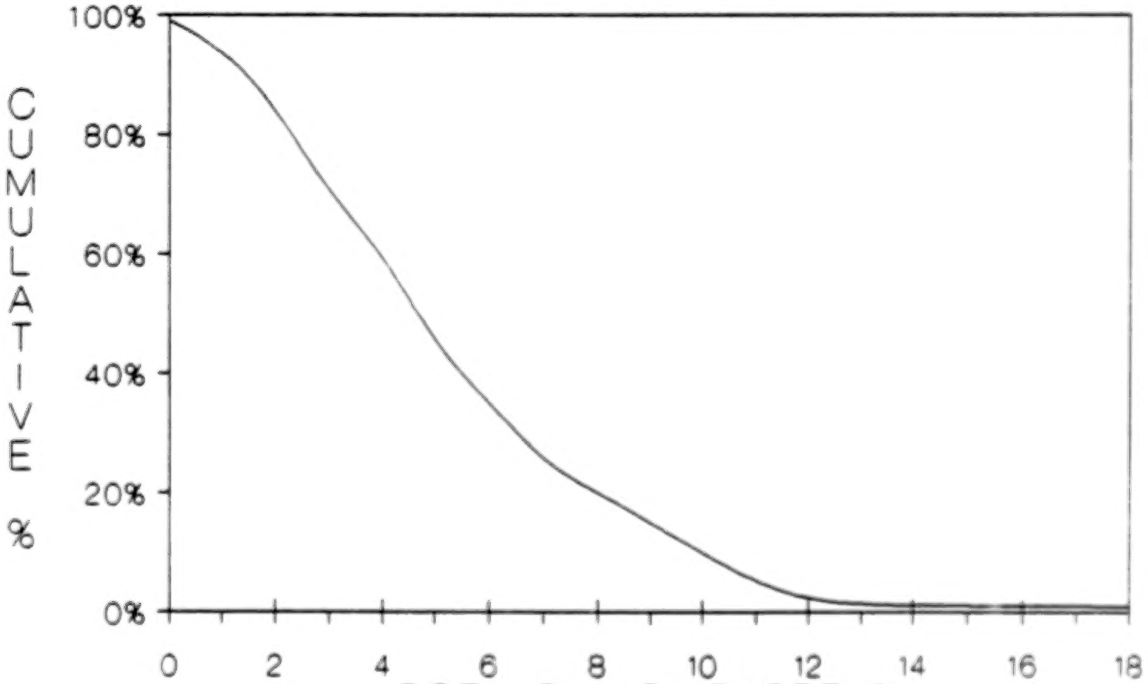
For the Western Gulf, the economically recoverable estimates are shown in the following chart:

	Oil (BBO)	Gas (tcf)
Conditional		
95th Percentile	0.18	3.58
Mean	1.42	21.22
5th Percentile	3.24	46.73
Marginal Probability = 1.00		
Risked		
95th Percentile	0.18	3.58
Mean	1.42	21.22
5th Percentile	3.24	46.73

Although estimates are shown at the 95th percentile, 5th percentile, and mean cases, these are only three possible numbers from a full and continuous distribution of possible values. Figures below show a conditional distribution for the economically recoverable resources in barrels of oil equivalent. Gas volumes are converted to barrels of oil on an energy equivalent basis and then added to the oil volume. One barrel of oil equivalent equals 5.62 Mcf of gas based on 5,8000,000 Btu/bbl and 1,032 Btu/cu ft of gas. Every point on these curves is equally likely to occur. However, the low and high estimates indicate the range of possible values and the conditional mean represents the average amount anticipated, given that recoverable hydrocarbons exist in at least one of the prospects modeled.



CONDITIONAL RESULTS - CENTRAL GULF



CONDITIONAL RESULTS - WESTERN GULF

Sale Area Estimates are prepared to comply with sale-specific analytical requirements related to environmental analyses and cost/benefit studies. Oftentimes the area offered for lease is smaller than the entire planning area. Therefore, prospects lying outside of the proposed sale area must be deleted from the assessment. These estimates are undiscovered, economically recoverable resources that are based on current economic and technological conditions and projections. Since these estimates are more area-specific and of nearer term use than planning area estimates, postulated (unmapped) prospects generally are not included, except where justified on a case-by-case basis.

For Central Gulf Lease Sale 123 and Western Gulf Lease Sale 125 the entire planning area is offered for lease. Therefore, the economically recoverable resource estimates for the entire area offered for lease are the same as those estimates for each planning area.

The sale area estimates represent the amount of undiscovered resources offered for lease. The *Resources Assumed to be Leased* represent an assessment by the MMS staff of the amount of resources that would be leased, discovered, and produced as a result of the sale and, therefore, the amount upon which the impact analysis is to be based. For proposed Sales 123 and 125, the MMS staff considered previous leasing rates, industry interest, prospect distribution, economic and technological considerations, and infrastructure distribution. Recognizing the inherent uncertainty associated with resource estimates, the EIS includes an analysis of a range of potential outcomes as represented by three distinct scenarios: (1) low case, (2) base case, and (3) high case. The low case is an exploration-only case, based on a scenario of a reasonably anticipated level of exploration activity, but assuming that no commercial accumulations are discovered. The low case scenario is analyzed in frontier planning areas. The base case includes an estimate of the resources assumed to be leased, developed, and produced, given that hydrocarbons exist in the area (i.e., a conditional estimate) and an estimate of the exploration, development, production, and transportation activities appropriate to that level of resources. The high case is an estimate of a significantly higher level of resource recovery and attendant exploration and development activity that could result from higher leasing interest than estimated for the base case or that could result from the discoveries of larger oil and gas accumulations than estimated under the base case assumptions. An examination of these levels of resources and subsequent development will cover the range of possible outcomes and impacts that could be anticipated to occur as a result of each sale.

The economically recoverable resources assumed to be leased as a result of Sale 123 are:

	Conditional Oil (BBO)	Conditional Gas (tcf)
Low Case	N.A.	N.A.
Base Case	0.17	1.64
High Case	0.33	3.01
Marginal Probability = 1.00		

The economically recoverable resources assumed to be leased as a result of Sale 125 are:

	Conditional Oil (BBO)	Conditional Gas (tcf)
Low Case	N.A.	N.A.
Base Case	0.10	1.48
High Case	0.22	3.18
Marginal Probability = 1.00		

The procedures used to determine these different categories of resource estimates are similar in all cases. While subjectivity exists in determining inputs and which prospects are likely to be leased, judgments are consistently applied by specialists in each discipline. For example, inputs such as acreage and net pay are provided by geologists, reservoir engineering parameters are estimated by petroleum engineers, and so forth. The advantages of the model are that subjective judgments of subject matter experts are handled in an objective manner and written documentation of the various judgments is provided so that the estimates can be readily updated in the future as new information and interpretations become available.

Exploration and Development Scenarios

Infrastructure for each EIS scenario (high, base, and low cases) is estimated for the Exploration and Development (E&D) Report based on the amounts of conditional resources assumed to be leased and subsequently discovered and developed. The E&D Report is composed of timetables with the yearly numbers of successful and unsuccessful exploration, delineation, and production wells for oil and gas, the number of platforms; oil and gas pipeline miles; and production schedules. The E&D infrastructure is estimated using methodologies that are specific to each MMS Region and that are based on the amount of historical information available, the evaluator's professional judgment, and the geologic, engineering, and economic uncertainties associated with each sale area.

Appendix D

Gulf of Mexico Oil and Gas Lease Sales

State Oil and Gas Lease Sales

Offshore leasing activities in State coastal waters dates back to 1922 when the State of Texas issued its first offshore Gulf of Mexico lease. The separation between Federal and State offshore jurisdiction was legislatively established in 1953 by the enactment of the Submerged Lands Act (43 U.S.C. 1301-1315). This Act was judicially interpreted for the coastal States of the Gulf of Mexico by the U.S. Supreme Court in its 1960 decision U.S. vs States of Louisiana, Texas, Mississippi, Alabama, and Florida, No. 11 original (363 US 1,121). Jurisdiction of the Gulf Coast States over submerged lands and the resources therein was held by the U.S. Supreme Court to extend three nautical miles from their coasts, except for the Gulf Coasts of Texas and Florida where jurisdiction was established as extending three marine leagues, or approximately 10.35 statute miles. Table D-1 identifies recent Gulf of Mexico State offshore sales and proposed future sales.

Alabama

The principal regulatory body for oil and gas activities in the State of Alabama is the State Oil and Gas Board of Alabama. Alabama held its first offshore lease sale (coastal waters) on October 6, 1951; however, the first major sale was held in October 1969, and four leases totaling 19,695 acres were issued. Exploration has accelerated following the discovery of the Lower Mobile Bay - May Ann Field. The most recent offshore lease sale was held on July 19, 1988, and offered 366,698 acres. Six leases were finalized and none are pending. There are presently no plans to hold any future lease sales.

Mississippi

The responsibility for mineral leasing in the State of Mississippi coastal and State waters rests with the Commission on Natural Resources. Mississippi's first offshore lease sale was held on July 8, 1982, and offered 250,000 acres. The most recent offshore lease sale was held on January 16, 1985, and offered 250,000 acres (54 blocks). A total of 22,000 acres (4 blocks) and one tract totaling 20,000 acres were leased. There are presently no plans to hold any future lease sales.

Louisiana

The State of Louisiana held its first offshore lease sale on August 8, 1945; however, wells have been drilled off Louisiana since 1938. State offshore lease sales are held monthly under the authority of the nine member Louisiana State Mineral Board established in 1936. At the time of this writing, the most recent offshore lease sale was held on November 9, 1988, and offered a total of 17,923 acres. The next offshore lease sale is scheduled for December 14, 1988, and a total of 115,843 acres will be offered.

Texas

The principal regulatory body for oil and gas activities in the State of Texas is the School Land Board. Members of the Board are the Commissioner of the General Land Office and two citizens appointed by the Governor and Attorney General. The State of Texas held its first offshore Gulf of Mexico lease sale in 1922. Texas holds lease sales in April and October of each year. Between 1939 and 1988 the State of Texas has held 109 lease sales. The most recent offshore lease sale was held on October 7, 1988, and offered 431,838 acres. A total of 109 leases from this sale were granted. The next offshore lease sale is scheduled for April 4, 1989, and the number of acres to be offered is unknown at the time of this writing.

Florida

There are currently no plans to conduct State OCS lease sales.

Federal Oil and Gas Lease Sales

On September 28, 1945, Presidential Proclamation No. 2667 was signed declaring that the United States regarded the natural resources of the OCS subsoil and seabed as appertaining to and being subject to the jurisdiction and control of the United States. Executive Order No. 9633 was issued on that same day reserving certain resources of the OCS under the jurisdiction of the Secretary of the Interior. OCS leasing was authorized in 1953 and the first Federal Gulf of Mexico lease sale was held on October 13, 1954. A total of 394,721 acres were leased. Since that date, there have been 58 oil and gas lease sales and 6 salt and sulphur lease sales in the Gulf of Mexico. The largest Gulf of Mexico Federal offshore lease sale was held on May 25, 1983. A sum of $3,367,606,134 was generated from the 3,089,872 acres leased.

Of the 5,068 Federal leases in existence at the end of 1986, 83% were located in the Gulf of Mexico. One-eighth of the nation's domestic productions and one-fourth of its natural gas comes from Federal waters. Oil and gas lease operations and the management of leasing energy resources is guided by the Outer Continental Shelf Lands Act of 1953, as amended.

Oil and Gas Journal Newsletter reports that a Freeport-McMoRan sulfur find 30 miles east of the Mississippi River delta is North America's first commercial Frasch discovery in 30 years and one of the continent's largest.

Freeport, with three rigs, has identified a resource in excess of 50 million tons of sulfur in Main Pass Block 299 off Louisiana. Reserves at 1,500-1,800 ft, may support production of 2-3 million long tons/year. A recent gas blowout on the block has cost the loss of one drilling rig (USDI, MMS, January, 1989; Oil and Gas Journal, January 9, 1989; Visual No. 1; USDI, MMS, 1988).

Recent Gulf of Mexico Federal Offshore Lease Sale

	Central Gulf Sale 113	Western Gulf Sale 115	Eastern Gulf Sale 116
Date of Sale	3/30/88	8/31/88	11/16/88
Acres Offered	33,580,661	27,911,790,743	46,417,391.69
Number of Tracts Receiving Bids	684	270	115
Leases Granted	62	255	115[1]
Acres Receiving Bids	3,523,203	1,499,163.92	657,347.76
Acres Leased	3,416,759	1,412,763.92	657,347.76

[1] Operations may be granted contingent upon the opening of Military Reference Areas (see Visual No. 1E, Final EIS 113/115/116 and according to other requirements in those leases).

The next proposed Gulf of Mexico lease sale is scheduled for March 1989, when approximately 31,806,402.79 acres will be offered.

Sources: U.S. Dept. of the Interior. Minerals Management Service. 1988. Outer Continental Shelf Lease Offerings Statistics, July 1988.

U.S. Dept. of the Interior. Minerals Management Service. 1988. Preliminary Report,s OCS Lease Sale 115, August 1988.

U.S. Dept. of the Interior. Minerals Management Service. 1988. Revised Preliminary Report, OCS Lease Sale 116, November 1988.

U.S. Dept. of the Interior. Minerals Management Service. 1988. Unpublished Data from Leasing and Environment, Sales and Support Unit.

Table D-1

Gulf of Mexico State Offshore Lease Sales

State	Date of Last Sale	Acres Offered	Leases Granted	Acres Leased	Next Proposed Sale	Acres to Be Offered
Alabama	7/19/88	366,698	6	26,116	Unknown	n/a
Mississippi	1/16/85	250,000	5	42,000	Unknown at this time	n/a
Louisiana	1/09/88	17,923	20	7,744	12/14/88	115,843
Texas	10/07/88	431,838	109	61,587	4/04/88	Unknown at this time
Florida*	n/a	n/a	n/a	n/a	n/a	n/a

Sources: Florida Institute of Oceanography. 1984. A report on oil and gas leasing in Florida offshore waters. Volume I: A description of Florida's existing program and recommendations for revised procedures. St. Petersburg, FL: Florida Institute of Oceanography.

Louisiana Minerals Board. 1988. Personal communication.

Mississippi Bureau of Marine Resources. 1988. Personal communication.

State of Florida. Governor's Office. 1988. Personal communication.

State Oil and Gas Board of Alabama. 1988. Personal communication.

Texas General Land Office. 1988. Personal communication.

U.S. Dept. of the Interior. Minerals Management Service. 1983. Gulf of Mexico summary report, September 1983: Outer Continental Shelf oil and gas activities in the Gulf of Mexico and their onshore impacts. Prepared under Contract No. 14-08-00011-19719. Reston, VA and Philadelphia, PA: Rogers, Golden & Halpern, Inc. 106 pp.

U.S. Dept. of the Interior. Minerals Management Service. 1984. Gulf of Mexico summary report, September 1984: Outer Continental Shelf oil and gas activities in the Gulf of Mexico and their onshore impacts. Prepared under Contract No. 14-12-0001-30042. OCS Information Report/MMS 84-0073. Reston, VA: Rogers, Golden & Halpern, Inc. 108 pp.

U.S. Dept. of the Interior. Minerals Management Service. 1985. Gulf of Mexico summary report, October 1984 - September 1985: Outer Continental Shelf oil and gas activites in the Gulf of Mexico and their onshore impacts. Prepared under Contract No. 14-12-0001-30042. OCS Information Report/MMS 85-0083. Reston, VA: Rogers, Golden & Halpern, Inc. 108 pp.

*No plans to conduct OCS State lease sales.

Appendix E

Deepwater Benthic Communities--Notice to Lessees

U.S. DEPARTMENT OF THE INTERIOR
MINERALS MANAGEMENT SERVICE
GULF OF MEXICO OCS REGION

No. 88-11 Effective: February 1, 1989

NOTICE TO LESSEES AND OPERATORS OF FEDERAL OIL AND GAS LEASES IN THE OUTER CONTINENTAL SHELF GULF OF MEXICO OCS REGION

Implementation of Measures to Detect and Protect Deepwater Chemosynthetic Communities

A. Introduction and Background

Deepwater (greater than 400 m) chemosynthetic organisms have recently been discovered in the Gulf of Mexico (GOM). Chemosynthetic communities are assemblages of tubeworms, clams, mussels, bacteria mats, and other associated organisms. Many of the species, while similar to those of other deepwater areas, including the vent communities of the Galapagos Ridge, are new to science. While generally widespread and in low densities, there are examples of very high densities of the organisms in apparently very small, isolated areas. These areas of high-density communities are apparently associated with hydrocarbon seeps, vents or gaseous sediments. Oil and gas activities, which disturb the seafloor where such dense communities are located, will cause damage to any of these communities with which they come into contact. Such activities would include (but not be limited to) anchoring, placement of seafloor templates, and installation of pipelines.

Regulatory authority to require avoidance or protection of chemosynthetic communities and avoidance of shallow hazards, such as vents or gaseous sediments, appear at several places in 30 CFR 250. General provisions concerning protection of fish and other aquatic life are at 30 CFR 250.5(a) and 30 CFR 250.20(a). Specific provisions concerning sea bottom hazards at particular sites are at 30 CFR 250.33(b)(1)(ix) for exploration plans, 30 CFR 250.34(b)(1)(vii) for development and production plans, and 30 CFR.250.139(b)(2) for foundations.

Detailed data regarding the extent, location, structure, and relationship of these communities to the local geophysical environment are at present unavailable. Currently, operators in water depths greater than 400 m are required to provide certain data in order for Minerals Management Service (MMS) to make determinations regarding the possibility of chemosynthetic communities being present and the potential of their being harmed by exploration and development activities. These requirements were previously imposed on a case-by-case basis, however these requirements are now included in a letter to lessees dated October 12, 1988, which specifies information required for Plans of Exploration (POEs) and Development Operations Coordination Documents (DOCDs) for oil and gas leases in the GOM OCS Region.

B. Purpose and Scope

It is the purpose of this Notice To Lessees and Operators (NTL) to inform all operators of leases in water depths greater than 400 m of the requirements currently being imposed by MMS and to provide a consistent and comprehensive approach which will avoid damage to high-density chemosynthetic communities. The requirement of Part C below shall apply to all operations of GOM leases in water depths greater than 400 m and shall remain in effect until superseded.

C. Implementation

1. Beginning February 1, 1989, owners and operators of leases on blocks in water depths of 400 m or deeper in the GOM shall comply with the following:

    a. Prior to approvals of Applications for Permit to Drill (APDs) and Pipeline Applications, the operators shall delineate all seafloor areas which would be disturbed by the proposed operations. Additionally, an analysis of geophysical information for these areas, as well as any other pertinent information available, shall be furnished which discusses the possibility of disturbing geological phenomena (such as hydrocarbon charged sediments, seismic wipe-out zones, anomalous mounds or knolls, gas vents, or oil seeps) that could support chemosynthetic organisms.

    b. If the subsequent review by MMS of the analysis required by 1.a. above results in a determination that high-density chemosynthetic communities may be present and could potentially be harmed by the proposed activities, the operator will be required to:

        (1) modify the application to relocate the proposed operations to avoid impacting possible chemosynthetic communities; or

        (2) modify the application to provide additional information (perhaps including a photo-survey, a video-survey, or already available information) which documents whether high density chemosynthetic communities exist in the areas of concern; or

        (3) adhere to certain conditions of plan or application approval, such as use of a remotely operated vehicle to precisely set anchors, or to ensure that the proposed anchor pattern does not impact chemosynthetic communities, to monitor impacts caused by the proposed work, or any other condition deemed necessary by the Regional Director.

2. The requirements of this section may be revised as new information is received.

D. Intent

The provisions of this NTL are intended to provide clarification, description, or interpretation of requirements contained in OCS operating regulations and lease stipulations. This NTL does not impose additional requirements.

J. Rogers Pearcy
Regional Director
Gulf of Mexico OCS Region
Minerals Management Service

DEC 0 9 1988
Date

Approved:

Wm D. Bettenberg
Associate Director for
Offshore Minerals Management
Minerals Management Service

12/19-88
Date

Appendix F

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As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interest of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. Administration.

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